

THE RE-CONSTRUCTION OF REALITY:

TOWARDS ASSESSMENT OF OPERATIONAL CREATIVITY

For the degree of Ph.D. in Psychology

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ABSTRACT

This study is an attempt to examine the concept of creativity within a framework of Piagetian operational structuralism. Previous notions of creativity are examined and a re-definition is proposed. Because it is believed that creativity and intelligence cannot be separated, creativity is examined in relation to the development of knowledge as a whole.

In the first part of the research, a battery of creativity tasks was developed. The tasks, based on stated principles, were administered to a sample of 100 subjects ranging from 6-13 years of age. In the subsequent analysis, relationships between the test items were considered, also changes in performance as a function of age. A tentative analysis of the sub-categories of assessment was made and their implications for a stage-explanation of creativity considered.

The second part of the research examined the question of training for creativity and argued that all such training must be related to the cognitive abilities of the subjects concerned. Based on the findings in Part 1, a set of training tasks was constructed and an attempt was made to train 80 subjects between the ages of 7-10 years. An analysis of their performance in relation to their age and operational ability is made.

The research concludes with a proposal for a developmental scale of creative ability.

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Chapter 1

INTRODUCTION: TOWARDS A DEFINITION
OF CREATIVITY.

Before any meaningful re-construction of phenomena can take place, an individual must be capable of understanding the identity and structure of phenomena - or at least the phenomenon under consideration. An understanding of identity and of structure leads not only to a grasp of an object's wholeness, a realisation of its boundaries and defining properties, but makes possible reversibility, re-organisation and re-construction. An identity can be known from more than one standpoint. Shifts in perception (e.g. figure-ground) can lead to an increased understanding of identity. An ability accurately to define an identity or identities could be regarded as one index of comprehension. Such definitions need not be verbal.

The concept of identity is central to this study. It is seen as a first and essential step in the process of creative transformations and could be regarded as an extension of Piaget's notion of 'object concept'. A very adequate explanation of what object concept involves is offered by Flavell (1963):

"For Piaget, a mature conception of objects most of all demands that an object be seen as an entity in its own right which exists and moves in a space both common to it and to the subject who observes it. Moreover, and very important, the continued existence of the object must be construed as separate from and independent of the activity which the subject intermittently applies to it."

The definition implies the individual's realisation that the self is also one object among others and that, as a consequence, 'objective' constructions of reality become possible.

Whilst one can say that at a certain stage of cognitive development a child attains object concept, and that this attainment represents a

certain level of cognitive organisation, the knowing of objects is still affected by the ego-centricity of the child, and it is only at the formal operational stage that one could theoretically state that an individual had fully attained object concept. In other words, a period of refinement is required.

The link with creative re-structurings of reality is strong, for without an adequate grasp of an identity, its structure and defining properties, re-constructions will be limited and subject to distortion.

All creative knowing - which is an active and constructive process - is about identity transformation. An identity could be any single object or event, or any cluster of objects and events forming a recognisable whole. Single identities can be transformed in themselves. Identities can be related and changes brought about by means of the relationships.

Transformations can take place in one or some of the following ways:

- A1 Apprehension and re-definition of reality (an essential principle upon which all transformations are dependent).
- B1 Re-structuring of an identity (in the sense of re-organising existing component parts of an identity).
- B2 Addition(s) to an identity.
- B3 Subtraction(s) from an identity.
- B4 Multiplication or increase of an identity.
- B5 Relating of identities (including combination, synthesis and causality).
- B6 Adjusting identities.
- B7 Division(s) of identities.

All creative transformations of reality are governed by one or more of these principles. Essentially, such principles are assumptions, arrived at by consideration of ways of organising and of re-organising reality.

The quality of these transformations will be dependent primarily upon an adequate grasp of the identity of the phenomenon concerned. All such transformations can be carried out at a concrete or formal operational level. Non-operational transformations would be chance-like performances lacking the permanence and repeatability of operational activity. Transformations of reality can lead to convergent (logical) conclusions or to what might be termed divergent conclusions. Transformations are expressed in different modes - symbolic, verbal, figural, etc.

The recognition and understanding of an object's identity permits of conscious variation or reconstruction at the level of that recognition and understanding. Identity transformation is possible at the level of a system of objects, events or symbols as well as at the level of individual items or events. Language is an instance of such a system.

To be potentially creative, an individual at some stage during the process has to comprehend the boundaries defining identities. Beyond given points, identities will change. Such given points will be determined by:

- a) the physical properties making up the phenomena;
- b) the flexibility of the rules governing the definition of an item or of a system.

SYMBOLIC TRANSFORMATIONS OF IDENTITIES

Before an individual can carry out symbolic transformations, he must have some comprehension of standard modes of classifying and of ordering phenomena, and of symbolic groupings and symbolic associations. This is essential if he is to recognise his own efforts as some kind of departure from a normative system. Symbolic transformations involve the establishment of relationships and identities on a symbolic basis. Within the

classification systems of a culture, groupings might be based on physical properties, usage or association. Often such classification systems appear to be arbitrary in terms of criteria, at times being based on an aspect of an item rather than upon the item as a whole. In a "red-shiny" classification, for instance, other features of the item would be ignored and very diverse objects could be included on the basis of the criteria. However, in an "all snowflakes" classification the wholeness of the object would be more readily included. The logic governing a culture's way of interpreting reality cannot always be discovered by deduction. Its abstract and sometimes arbitrary nature can require that individuals be taught about it in some way.

There is, however, a more profound requirement rooted in Piaget's concept of operational knowledge which is this. An individual may learn a number of classification systems but if he is to be reflective and potentially creative, he must grasp the concept of classification itself. Given such knowledge, an individual might seek or discover new classifications based on symbolic, subjective criteria. He will be aware of his relating on the basis of criteria not commonly employed. Such awareness of deviation is essential to any creative departure.

A symbolic response can also be subjective and ego-centric in nature. Such responses are not conscious or deliberate deviations. They stem rather from a lack of knowledge and from cognitive limitations. This study is concerned with the deliberate and conscious uses of such classifications and transformations of identities and not with involuntary ego-centric responses.

Creative behaviour then is a way of acting upon phenomena. A creative action transforms objects and events in the sense that they are perceived, constructed and related in novel and unexpected ways. An individual might well set out deliberately to scan objects and events from

various standpoints. Such initial deliberation is not essential; what is essential is that at some point during the process the individual becomes aware of his own activity and the effects of that activity upon the organisation and re-organisation of reality. Without such awareness, he will be unable to recognise and evaluate his own behaviour and such conditions are essential to creative transformations.

Creative behaviour is not a behaviour per se. It manifests itself in various modes. It is the cognitive abilities and dispositions of the individual at a given time which define an act as creative in terms of process. A creative process does not guarantee a creative product (Guilford, 1965). An individual may discover, he may set up between phenomena, relationships which are new to his experience, but which to the experience of others could be common-place. This does not render his own experience any less novel or any less creative in terms of process, only perhaps in terms of product.

There is raised here the whole question of cultural recognition or approval of creative activities, and a distinction must be made between this kind of recognition and the essential process of transformation of identity. Many activities which are creative in their searching, transformations and evaluations may well pass unnoticed by others. Similarly, a social label: "creative" is no description or assurance of the quality of process behind the product. Cultural labels in no way define a creative process. A critical point here is that of the distinction which exists between identities as culturally defined and identities which can be recognised by virtue of their structural forms. On this point there are certain affinities with Gestalt explanations. Early

this century, Wolfgang Kohler wrote as follows:

"... Gestalt psychology holds that sensory units have acquired names, have become richly symbolic, and are now known to have certain practical uses, nevertheless they existed as units before any of these further facts were added."

There is a passive dimension to early Gestalt explanations which is rejected by Piaget, but this distinction between what might be termed "structure", and cultural labelling of structures, has implications for creative transformations. It might be useful to develop this point through examples. An individual in a creative exercise might combine two identities -

identity X combined with identity Y = identity Z.

In such combinations, perceptual shifts are vital. If we continue to "perceive" this combination of X and Y as XY we shall be unable to perceive what could be a new structural form - namely Z. In other words, by continuing to perceive already identified structures, and especially culturally labelled structures, we may delay or prevent the discovery of a new structural form, which once identified will no doubt receive a new cultural label. In this sense, therefore, a creative structure is independent of the known form(s) through which it is expressed. In practical terms, hybrids can be explained in this way. A hybrid can only come into existence when we cease to focus entirely on its component parts, and move instead to know the identity through the relating of such parts.

Cultural labels provide us with a certain kind of assurance. Research in the area of language - and especially that concerned with deafness - has indicated that when materials, forms, shapes are labelled, they are

more readily recognised and remembered (e.g. Robertson and Youniss, 1969). It is suggested that a problem of creative training might be that of overcoming such labels which encourage individuals to perceive reality in culturally labelled forms. It is the structures underlying such forms that will give rise to new creations once they are identified and developed.

Just as cultural labels do not make a creative process, a creative process in itself need not necessarily lead to a creative product or transformation either in terms of the individual's recognition of the process or that of the cultures. Correct logical behaviour leads to a correct logical outcome. As Bartlett (1965) has pointed out, this stems from the fact that such thinking is "closed-system" thinking. The conclusions are known in advance and concern is with the steps leading to that conclusion, i.e. with an interim process. However, what Bartlett has termed "adventurous thinking" falls into a different category. Here conclusions cannot be known in advance. It is the nature of the process that such cannot be so. There is no known or specific conclusion so concern is with the process and with the recognition of a conclusion when such is discovered. Recognition can occur at any stage of exploration and not necessarily at the initial stages, though its occurrence will mark a new stage in the exploration.

In the convergent-type problem where a response is already known, the task of the subject is to discover the logic of the problem. Gestalt psychologists would speak here of "vectors" which give, or can give, direction to the problem-solving process. In divergent-type problems there is no vector in the above sense. Here the subject has to discover

Robertson, A. and Youniss, J. (1969) "Anticipating visual imagery in deaf and hearing children". Ch. Devt. 40, pp 123-35.

Bartlett, F.C. (1965) Thinking: An Experimental Study.

and recognise conclusions and in a certain sense invent new vectors governing and leading to these new logics. The creative thinker has, in effect, to discover both the solution and the process.

A non-creative outcome could result from several factors:

- a) a poor manipulation of identities;
- b) non-recognition and so non-definition of a new structural form;
- c) poor grasp of its implications and follow up.

This idea of a non-creative result is of interest with regard to the young child's behaviour. Some knowledge is essential for creative reconstructions of reality. The child's early encounters with reality and its organisation have strongly convergent pressures attached to them. He learns through experience, sometimes ordered experience, to "know" a limited number of identities. Such identities are almost always culturally recognised and labelled. A child may come to know a square form as an identity and his own manipulations might lead him to the conclusion, at a simple, non-operational level, that the components of the square could be used to other purposes - i.e. to construct other identities. Insofar as he is aware of the identity of the square and of his own transformations, such behaviour could be said to be potentially creative to a point. But, as will be suggested, there are certain factors missing. However, the point at issue for the moment is that a certain quality of creative behaviour can exist within the limited knowledge of the child. The wider one's knowledge, the wider the field for creative explorations. This is not unlike the notion of "decalage" as explained by Piaget (horizontal). *(note)

*(note): "... (while) it may be useful to think of an individual as being generally characterised by a given cognitive structure, he will not necessarily be able to perform within that structure for all tasks. Task contents do differ in the extent to which they resist and inhibit the application of cognitive structures." Flavell, J. (1963) Ibid. P.23.

This leads again to the idea that creativity might be most usefully considered as process rather than product, and that the process is made up of several phases - not all of which the child is able to complete, and his way of handling each step of the process will vary qualitatively from adult ways. After consideration of Wallas (1926), Ghiselin (1955), Rogers (1959) and others, it is proposed that the process of creativity might best be considered as falling into the following three phases.

1. Apprehension of the problems

This is the first step in any creative process, though it may well be preceded by less conscious searchings and exploratory transformations. The amount and kind of knowledge required will vary according to the task. Similarly, there can be no agreed amount of time. It is possible, given certain tasks or problems, that the problem and solution could appear together - for instance, a perceptual shift leading to a re-definition could both define the problem in a different light and offer the way to its solution.

2. Experimental transformations

Such may be deliberate, stemming from conscious effort. The time-span cannot be specified. There may be a deliberate incubation period - or apparently no incubation at all in that the individual is not conscious of such a period. An increase in specialised knowledge may be a requirement depending upon the nature of the problem or issue. The solution may be rapid or attained slowly with each step apparent. On the other hand, there may be no solution or no end product to draw the process to a close.

Wallas, G. (1926) The Art of Thought.

Ghiselin, B. (1955) The Creative Process.

Rogers, C.R. (1959) "Toward a theory of creativity" in: H.H. Anderson (ed) Creativity and its Cultivation. pp 69-82.

3. Evaluation

In practice, this is difficult to separate from the previous stage in the process. However, evaluation may be deliberately suspended for a time (as in "Brainstorming" for instance) though more normally it could accompany each step of the whole process.

Theoretically, this process could be carried out by the cognitively mature 'ideal type' (Weber) adult. The child, especially the pre-operational and concrete-operational child, is more likely to display qualitative differences in his apprehension of the problem and in his experimental transformations. He may never attain the stage of conscious evaluation. A child at either of these stages of development might combine as follows:

identity A and B to produce identity C.

At the level of the objects the child may realise that he has produced a different identity and could, to this degree, be regarded as creative in attitude and action. However, his grasp of the transformation (in this case combining of identities) will be confined to the immediate concrete act itself. He is less capable of comprehending the process itself and of realising the effects of his actions upon phenomena.

The process of creativity might normally be carried through by one individual or a group of individuals - in both cases, those concerned would participate in the process from its start. However, it is possible that a child, lacking some or many of the cognitive qualities required for the whole process of creative transformations, could initiate a process for an observer who is 'cognitively mature'. The child's initiatory processes would of course stem from cognitive immaturity as opposed to cognitive divergence, but they could present - were they recognised - the possibility of a novel identity and the possibility could be continued through by an adult knower.

THE GENESIS OF CREATIVE STRUCTURES

Piaget (1971) has considered this question with regard to the genesis and formation of logical structures. Here must be posed the question: what is the relationship between logical and creative type structures, or - are there separate cognitive structures for creative behaviour? Further, if such separate structures exist, how is their existence to be explained?

As Piaget has pointed out (1971), genetic explanations have often taken off from two extreme standpoints: those with atomistic tendencies and those concerned with emergent totalities. Piaget proposes a third explanation - that of operational structuralism - a position adopted in this present explanation of creative behaviour. Operational structuralism:

"... adopts from the start a relational perspective, according to which it is neither the elements nor a whole that comes about in a manner one knows not how, but the relations among the elements that count. In other words, the logical procedures or natural processes by which the whole is formed are primary, not the whole, which is consequent on the system's laws of composition, or the elements."

Implicit in this theory of operational structuralism is the idea that structures are constructed and that it takes time before they are fully developed and defined. Further, generation is always a passing from simple to more complex structures. Piaget (1971) speaks of a structure as:

"... a system of transformations... In short the notion of structure is comprised of three key ideas: the idea of wholeness, the idea of transformation, and the idea of self-regulation."

It is through functioning that such structural behaviour becomes differentiated, and early functioning is concerned with "general co-ordinations of actions" (sensori-motor organisation) behind which one cannot go (Piaget *ibid*). The dynamic factors are of course assimilation and accommodation, whilst the movement towards equilibration is a kind of monitor.

Creative and logical structures are one and the same thing.

Theoretically, it would be inconsistent, somewhat atomistic, to explain creative behaviour by means of two sets of structures. In describing logical structures, Piaget points out that structures are inseparable from performance, from functions in the biological sense of the word (*ibid*). It is this inseparable relationship of structure and function which explains creative structures.

Essentially, a cognitive structure is a way of speaking about an 'ability'. A particular ability may involve perceiving, and actively understanding phenomena from varied standpoints. The standpoints may be well known, rule-governed standpoints and this would be about logical behaviour, in the general sense of the term. That same structure, that same ability, may be applied by the individual to more divergent processes. A phenomenon may be constructed, understood from standpoints which are not governed by rules, because as yet such rules are not part of a culture's logic. This activity, rooted in the same cognitive structure, could be about divergent, creative-type behaviour. In other words, cognitive structures are applied to problems of different natures and different processes. It is in the functioning that a structure not only develops, but further, develops a facility (fluency) to apprehend phenomena of a particular kind and in a particular style. Functioning governs the growth of cognitive style. As is consistent with Piaget's explanation of knowing, prime importance is given to the knower who is conceived of in active, constructing terms:

"If cognitive structures were static, the subject would indeed be a superfluous entity."

Not only does the subject play the central role in terms of bringing structures into being, his cognitive experiences determine the flexibility of his cognitive structures in terms of apprehension and interpretation of different kinds of problems and outcomes. Creative behaviour is most likely to come about when the individual is familiar with the contexts and objects upon which and with which he is operating. There is, therefore, a need to explore unfamiliar contexts if creative conclusions are to emerge from other than familiar contexts. Such explorations might be seen in terms of preparation or facilitation and in themselves might appear to be somewhat aimless. However, such could be the breeding ground for creative endeavours.

Creative behaviour is seen, in this study, as falling into three main developmental stages, distinct on qualitative grounds and exactly paralleling those stages outlined by Piaget. The stages are as follows:

1. Autistic Transformations

During this stage, subjects are capable only, or largely, of responses of an autistic or symbolic nature. In fact, such responses tend to come 'naturally' and they are to be distinguished from self chosen, conscious adult responses of a symbolic kind. From the subject's standpoint, there is nothing imaginative or organised about them, rather they are rooted in confusion and phantasy.

2. Concrete Transformations

A level of organisation appears here. In a concrete way the child becomes capable of transformations but he is tied to immediate conclusions. Because he knows now what is, with regard to identities presented in a concrete way, he is able to explore what could be - but only with concrete materials. This limitation - the inability to enter the zone of the imaginary and hypothetical, means that his explorations and transformations are limited to step-by-step discoveries.

3. Formal Transformations

The formal-operational child enters the world of the abstract, the formally organised in Piaget's sense with the full possibility of "what might be". His explorations are "mental" explorations, and even when there is resort to the concrete, the manner of the exploration here is more organised and reflects the quality of the thinking behind the organisation. At this stage, the child is capable of increasing objectivity, of understanding the reasons for rules and the implications of deviation from such rules. He is capable of evaluation.

Implicit in this discussion is the belief that distinctions such as "intelligence" and "creative behaviour" are false. Essential processes concerned with "knowing" can be directed to divergent or to convergent ends: an individual can combine, adjust, etc., to produce convergent or divergent products or end results. Whatever the direction his efforts will rest on the same cognitive structures. The use of the structures will be determined to some extent by the nature and direction of the problem. A helpful distinction might be made here between the existence of an ability and fluency in that same ability. Existence of ability is seen as being dependent upon operational structures; fluency is expected to be affected by factors such as experience. Often cognitive abilities are most frequently engaged in convergent-like tasks and considerations, and they may (if one can speak so concretely) be less well-oiled in the direction of divergent tasks. This is a matter of balancing formative experiences - it is not a question of two distinct modes of cognitive ability.

The distinction between 'ability' and 'fluency' in a discussion of operational creativity leads to some mention of symbolic behaviour and imagination in the child. Piaget argues that the young child has no

imagination (1951). Essentially Piaget is talking about the child's ability to make certain kinds of mental representations. Flavell (1963) notes that as the child develops, his imaginal activity becomes more mobile and flexible, able to anticipate the successive movements of yet to be transformations. Whilst such an ability is closely related to operational thought, it does not account for the genesis of that thought. In his analysis of the fourth stage of play, Piaget explains that there comes about in the child, with the co-ordination of secondary schemas, ritualisation. This is seen by Piaget as a preparation for the next stage in which ritualisation is accentuated and during which preparation for symbolic activity occurs. The ability to indulge in ritual, in this sense, implies some ability to make some distinction between the real and the phantastic. In Piaget's fifth stage of play, there comes about, owing to definite progress in the direction of representation, the dissociation of the ludic symbol from ritual. This ludic symbol takes on the form of symbolic schemas:

"All that is needed for the ludic to become a symbol is that the child is aware of the make-believe of the situation."

Within Piaget's system, the explanation can be given in terms of the ratio between assimilation and accommodation.

Symbol for Piaget implies a resemblance between signifier and signified. It is a personal thing and unlike a sign does not involve a social relationship. The child's symbolic games for instance, imply representation of an absent object. Symbolism is then seen as a preparation for the construction of representation, and free assimilation becomes creative imagination. In primary symbolism, when a child consciously assimilates one object with another (e.g. Piaget gives the example of the child

Piaget, J. (1951) Play, Dreams and Imitation in Childhood. P.130.

Flavell, J. (1963) Ibid.

treating a shell on a box as a cat on the wall), because of the consciousness of the activity, the child is moving from the realm of chaos and phantasy towards the area of creative imagination (ibid).

Such symbolic behaviour is important to an understanding of creative behaviour for it says much about the child's developing attitudes towards reality. In this representational activity the child treats reality in a new way. Objects and events become what he wishes them to become, and yet he possesses the ability to know their social reality.

Whilst imagination has no essential role in providing structures for intellectual (including creative) development, but rather is itself dependent upon intellectual structures, imagination as understood here is essential to mature creative thought. It allows the thinker to enter the domain of "what might be" which is a step beyond mental exploration of "what is". Imagination is a way of representing thought.

Creativity is short-lived. Much must be unrecognised. When a creative process leads to a creative outcome or product, there has to be recognition and public approval of that product. This raises the question - is creativity essentially subjective in that a particular construction of reality is limited to an individual? At its inception - at the point in time when reality is newly understood - it is subjective to that perceiver. To the extent that there is a shared understanding of this new conception, the re-construction will become shared knowledge and more objective. For a relatively short time, new constructions of reality will hold the label 'creative', but will eventually take their place within the heritage of knowledge as something 'known'. Depending upon their value to society, products and outcomes may be handed down to members of a culture within the socialisation process, and for many, therefore, will become

knowledge which is 'learned' and not something discovered or constructed for oneself. No understanding of creativity is possible without an appreciation of the culture in which thought has been socialised. One must understand the normative for deviance to exist or to be recognised as such by others.

Chapter 2

THE ORGANISATION OF KNOWLEDGE

"To know an object is to act on it. To know is to modify, to transform the object, and to understand the process of this transformation, and as a consequence to understand the way the object is constructed. An operation is thus the essence of knowledge; it is an interiorised action which modifies the object of knowledge." (Piaget, 1972)

An operation is the essence of knowledge and it must consequently be the essence of creative behaviour, which is a way of knowing and of transforming objects and events. Full creative thinking, like mature logical thinking, requires a high degree of awareness. It involves the recognition and understanding of a logical or generally agreed way of interpreting reality, and the realisation that there could be other ways of acting upon and of interpreting such events.

What is regarded as creative in a given culture, must be understood in relation to the normative of that culture, for whilst creative behaviour involves deviation from the normative, it requires a recognition of what is normative. Crucial to creativity is the ability to operationalise. When an individual is capable of operational activity - especially formal operational activity - he is capable of appreciating the wholeness of an act or event, its structure and identity. Such awareness can lead to realisation and appreciation of other modes of constructing reality.

This study leans heavily upon Piagetian inspiration, accepting a developmental-stage standpoint, but whilst attempting to examine ability to be creative, recognition is given to the cultural context in which knowledge is necessarily socialised, accepting that intelligent-creative behaviour must begin with what is known and in the forms in which knowledge is transmitted.

Piaget, J. (1972) "Development and learning" in: Readings in Child Behaviour & Development. Lavatelli.C.S. & Stendler.F.(Eds).P.38.

The organisation of knowledge can be viewed from two standpoints: it can be concerned with the organisation of the individual's knowledge-system within his culture ("inside" organisation) or it can refer to the ways in which society organises reality and passes on this organisation to its members ("social" organisation of reality). Piaget is primarily concerned with "inside organisation", though more recently he has been more ready to admit the force of culture upon cognitive organisation:

"Psychology elaborated in our environment, which is characterised by a certain culture and a certain language, remains essentially conjectural as long as the necessary cross-cultural material has not been gathered as a control." (Piaget, 1966)

Within any culture, the knowledge system of an individual will normally become increasingly organised. Operations may bear upon varying content but in themselves they will obey the same structural laws. Conservation for instance, is an index of a certain level of organisation within cultures where conservation is a reality. The task of the researcher is to discover indices which are valid to the culture.

Culture may not simply affect the content upon which an individual is to operate, his attainment of Piagetian stages may also be affected. Dasen (1972):

"... it can no longer be assumed that adults of all societies reach the concrete operational stage... However, it is the rate of development which is in question, not the structure of thinking. As such, the generality of Piaget's system is not threatened."

There is a basis of agreement which allows for increasing organisation of the individual's knowledge system and for the fact that such organisation is characterised by stage-description and explanation. What is required

Piaget, J. (1966) "Need and significance of cross-cultural studies in genetic psychology", Internat. J. of Psy. 1. 1 pp 3-13.

Dasen, P.R. (1972) "Cross cultural Piagetian research: a summary", reported in: Culture and Cognition: Readings in Cross Cultural Psychology, Berry, J. and Dasen, P. (eds). P.418

however, is a truly cross-cultural approach to such studies as opposed to centri-cultural studies (Wober, 1969). Much cross-cultural research falls into this latter category, attempting to study thought-patterns which are essentially Western, putting Western questions stemming from Western logics, sometimes making some concessions to the culture concerned by substituting Western materials for more culturally appropriate ones. Gladwin (1964) referring to the Trukese describes the different cognitive strategies employed by different cultures in problem solving:

"Both we and the Trukese operate within a 'gestalt' - a conception of the problem as a whole. However, we seek a unifying concept which will comprehend all the relevant facts more or less simultaneously, developing an overall principle or plan from which individual steps towards a solution can be derived deductively. In contrast, the Trukese work towards a solution by improvising each step, but always with the final goal in mind."

Essentially, what is required is a Piagetian, clinical-type probing across cultures to discover non-Western constructions of reality. On such a basis, more legitimate indices of cognitive organisation for specific cultures might be arrived at.

Commenting on cultural organisation and interpretation of reality ("outside" or social organisation) Bruner says:

"To one raised in Western culture, things that are treated as if they were equivalent seem not like man-made classes but like the products of nature... but there exists a near infinitude of ways of grouping events in terms of discriminable properties, and we avail ourselves of only a few of these."

Okonjii (1971), studying the effects of familiarity upon classification, noticed amongst other things that about 25% of the Ibusa subjects (in the 6-8 years group) in his sample classified on the basis of colour

Wober, M. (1969) "Distinguishing centri-cultural from cross-cultural test and research", Percept. Motor Skills, 28 488.

Gladwin, T. (1964) "Culture and logical processes". Reported in Berry, J. and Dasen, P. (ibid) P.30.

Bruner, J. et al (1967) A Study of Thinking. P.7.

Okonjii, O. (1971) "The effects of familiarity on classification", J. of Cross-Cultural Psy. 2(1) pp 39-49.

whilst none of their Glaswegian counterparts did so. Okonjii reports evidence in African studies of this relative dominance of colour in classificatory activities. Witkin (1969) reported a more marked field independence among the Eskimo than among their Western counterparts suggesting that so called 'primitive' groups are not uniformly less developed.

Coming to terms with knowledge, learning to organise it, involves becoming arbitrary, ignoring perceptual persuasions, forceful in their immediacy. It requires an understanding of contexts, of cues and of rules which transform phenomena irrespective of literal representation. This growth includes the development of many abilities: those of language, of perceptual adaptation and refinement of perceptual abilities, to mention but a few. How the child constructs reality is a function of the level of his cognitive organisation, and that organisation has to be understood within cultural contexts.

Socialisation into a culture's way of interpreting reality involves a gradual acceptance of a largely arbitrary and abstract-meaning system. Cultures vary in their criteria for interpretation, and in so doing, produce cognitive styles which reflect these criteria. Maccoby and Modiano (1966) in a study of equivalence transformations with North American and Mexican children support this point. Both groups of subjects began life regarding objects in terms of perceptible and concrete characteristics. Both groups of children were clearly impressionistic and immediate in their attempts to explain these realities, but with time and age their cognitive paths separated, illustrating the very different cognitive styles of their cultures. The North American child turned out eventually to give great emphasis to abstract qualities:

Witkin, H.A. (1969) "Cognitive styles across cultures". Internat. J. of Psy. 2(4) pp 233-250.

Maccoby, M. and Modiano, N. (1966) On "Culture and equivalence (I)" in: Studies in Cognitive Growth, Bruner, Olver, Greenfield. P.261.

"... at worst, he merely manipulates things in a formal and increasingly reductionist manner. In fact, a few of the older children completely lose the ability to analyse, because the concrete attributes of objects have become buried beneath formal and abstract notions."

The Mexican child on the other hand, became increasingly detailed in his perceptions of objects, making finer and finer perceptual discriminations. Maccoby and Modiano were essentially concerned to look at equivalence transformations and the generality of stages of growth in this area, but their observations illustrate the effects of culture upon ways of approaching and of interpreting reality.

Knowledge can be examined in terms of a culture's knowledge system, it can also be considered from the standpoint of the developing knower, who, within a given culture, has to come to terms with the meaning of reality.

The child is unsocialised in terms of his culture's meaning system. Bruner (1967) discussing the arbitrary dimension of much interpretation and with specific reference to ways of categorising says:

"They (i.e. categories) exist as inventions, not as discoveries." An individual requires experience within a culture to learn to construct reality from the standpoint of the culture. The child has a yet further limitation, for not only does he lack objective knowledge of his culture's way of organising reality, he is essentially ego-centric and lacking in cognitive stability. Research has suggested that there are perceptual inclinations and attractions which are beyond the control of the child at different points in his development. Goodenough, as early as 1929, illustrated the dominance of colour and form perception at different ages. Rabello (1933) supported these findings, noting that colour preference

Bruner, J. (1967) A Study of Thinking. P.7.

Brian, C.R. and Goodenough, F. (1929) "The relative potency of colour and form perception at different ages", J. of Exptal Psy. 12. pp 197-213.

Rabello, S. (1966) cited in translation in Kidd and Rivoire, Perceptual

decreased with age, giving place to form perception. Vinacke (1951) examined the concept of 'middleness' - the ability to select middle-sized objects as distinct from big or small objects. He found that this concept was not well developed until about nine years of age. Gibson et al (1962) investigated the matter of the child's perception of orientation. By eight years of age she found that the children were attending to the orientation of objects. Essentially hers can be described as an attentional theory, and more recently she (Gibson, 1969) has developed the idea that in our perceptions, particular dimensions vary in relevance with age. Gibson argues that we select what to attend to in a systematic manner and according to what past experience has shown us to be of relevance.

Bruner (1967) summarising the findings of research in this area points out that non-schematised imagery is highly characteristic of early intellectual operations. He refers to the child as concentrating upon surface properties of the environment and preferring perceptual bases for organisation and classifications of reality.

Francoise Frank's (1966) work is based on the classical conservation test of Piaget (but in a modified form) and points to the fact that perceptual information, because of its very immediacy, can impede the child in his pursuit of a culture's logic and his acceptance of an arbitrary meaning system. Frank found, for instance, that when containers were screened in the classical conservation task, that is when visual stimuli were not present to the subjects, even the four year olds were able to

Vinacke, W.E. (1951) "The investigation of concept formation", Psy. Bull. 48. pp 1-31.

Gibson, E.J. et al (1962) "A developmental study of the discrimination of letter like forms", J. Compar. Physiol. 55. pp 897-906.

Gibson, E.J. (1969) Principles of Perceptual Learning and Development.

Bruner, J. (1967) A Study of Thinking.

Frank, F. (1966) "Perception and language in conservation" in: Studies in Cognitive Growth. Bruner. J. et al.

give logically correct responses and explanations such as: "You only poured it". Protected from the visual stimuli, they seemed capable of accepting what Piaget has termed: "a logical necessity". (Piaget, 1972).

Perhaps it is worth pointing out that Frank's interpretation has been challenged by Bryant (1974) who explains the child's behaviour in this instance in terms of conflicting hypotheses, suggesting that the child is really suffering from cue conflict, not knowing on what dimensions of the visual evidence he is meant to act. Bryant maintains that certain training techniques concerned to indicate the visual cues to be employed by the subjects could help the child overcome the problem. However, whatever explanation might be correct, in the face of such visual stimuli, young children can fail to come to terms with a generally accepted logic.

Miller and Heldmeyer (1975) are critical of such standard conservation tests, and their criticisms offer valuable insights into some of the child's problems of cognitive organisation. They argue that conservation (of liquid in this case) is not an all-or-none ability but consists rather of several levels, and that such levels can only be detected by sensitive assessment conditions - "facilitating conditions". Screening procedures might be seen as facilitating. Standard conservation tests themselves require a certain degree of organisation on the part of the child. 'Emergent' organisation is a delicate commodity.

Piaget, J. (1972) "Development and learning" in: Readings in Child Behaviour & Development. Lavatelli.C.& Stendler.F.(eds). P. 40.

Bryant, P. (1974) Perception and Understanding in Young Children.

Miller, P. and Heldmeyer, K. (1975) "Perceptual information in conservation: effects of screening". Ch. Devt. 46. 588-592.

Theories supporting such researches into the field of perception vary in their interpretation of the activity. There are those theorists who speak of perception as distinct from more conceptual activities.

Piaget takes up a somewhat unexpected position for which he has earned the name - "the two Piagets":

"We will call perception the most direct or immediate possible knowledge of a present object in the sensorial field without affirming, however, that there exists a knowledge which is completely direct or immediate."

Bruner (1957) makes no such distinction, speaking of perception as an act of categorisation:

"... it is evident that one of the principal characteristics of perceiving is a characteristic of cognition generally. There is no reason to assume that the laws governing inferences of this kind are discontinuous as one moves from perceptual to more conceptual activities."

Gibson and Olum (1960) discuss organisational features of perception in the child. Perception is characterised by "stuckness" - i.e. it is non-transformable, its organisation is diffuse and it is dynamic in the sense that it is closely related to action. It is further described as non-schematised and ego-centric - in the sense that the child is the central reference point, and there is general unsteadiness.

Whatever the interpretations underpinning findings, it is evident that the perceptions of the developing child are characterised by a lack of organisation and that this has critical consequences for the ways in which he interprets reality. This lack of organisation and of refinement of abilities is found in studies of other areas concerned with cognitive growth.

Piaget, J. (1954-5) "Le development de la perception de l'enfant a l'adulte" Bull. Psychol. Paris, 8. P.183

Bruner, J. (1957) "On perceptual readiness" in: Beyond the Information Given. P.8.

Gibson, E. and Olum, V. (1960) "Experimental methods of studying perception in children" in: Handbook of Res. Methods in Child Development. Mussen, P. (ed)

Werner and Kaplan (1950) looked at the acquisition of word meanings through verbal contexts and reported impressionistic, subjective responses from young subjects and a decrease in such responses with age. They noted:

"Children respond in a manner termed symbolic by society, as they have not yet been adequately obliged to accommodate to the constraints surrounding words. As yet they do not appreciate the arbitrary dimension of meaning. The reactions involve searching the stimuli before them and responding and eventually classifying on the bases of stimuli which have immediate significance for them."

With language, as with other meaning systems, the child has to come to terms with relationships and with rules governing such relationships. The sentence is an articulated pattern of words standing in a definite relationship to each other. It may be that the child will think that the meaning of the word is directly conveyed by its sound pattern, and he might not take cognizance of the presented verbal cues in the process of signifying. Werner and Kaplan (ibid) have indicated three main types of distortions in children's responses during the signification process:

- a) by assimilation of the sentence meaning.
- b) by contamination of the sentence meaning (i.e. parts of one sentence being added to another).
- c) concrete, ego-centric and imaginative meanings.

It is only as the child grows older that his learning takes on a contextual dimension and that he begins to, use language in order to learn language. (Ogden and Richards, 1953).

Jean Berko (1958) investigating the acquisition of morphological rules supports the findings of Werner and Kaplan. Using nonsense words

Werner, H. and Kaplan, E. (1950) "The acquisition of word meaning through verbal context: an experimental study". J. of Psy. 29. pp 251-257.

Ogden, C and Richards, I. (1930) The Meaning of Meaning.

Berko, J. (1958) "The child's learning of English morphology", Word, 14. pp 150-177.

(as did Werner and Kaplan), Berko required subjects to supply plurals, verb tenses, possessives, derivatives and compounds of those words. As might be expected there is a pattern of increasing language socialisation with age and exposure to English morphology.

This mode of responding is not always confined to children. In certain circumstances, adults may employ such methods, especially when contextual constraints are removed or reduced. Brown, Black and Horowitz (1955) found that native speakers of English were able to guess the meanings of words from unfamiliar languages, suggesting, they feel, that there is a culturally acquired phonetic symbolism derived from experience with a common native language. However, an important distinguishing feature between the symbolic responses of adults and those of children is that the former have the ability to assess their criteria as subjective or perceptual as opposed to contextually controlled, further they have accepted what Locke (1964) termed:

"a voluntary imposition, whereby (such) a word is made arbitrarily the mark of an idea."

This arbitrary dimension of meaning is difficult for a child to grasp.

Vygotsky (1962) commented on this:

"We can see how difficult it is for children to separate the name of an object from its attributes, which cling to the name when it is transferred, like possessions following their owner."

Employing computing techniques to cope with the extent of her data, Entwisle (1966) in her study of word associations of young children raises from another standpoint, this idea of stabilisation of a language system, and further, the notion that there are patterns of responses

Black, A., Brown, R. and Horowitz, A. (1955) "Phonetic symbolism in natural languages", J. of Ab. and Soc. Psy. 50. pp 388-93.

Locke, J. (1964) Essay concerning Human Understanding. P.12.

Vygotsky, L.S. (1962) Thought and Language. P.129.

Entwisle, D. (1966) Word Associations of Young Children.

according to stages of development. As will be mentioned later, such patterns must have important implications for association-type creativity tests. The determinism, if any, of such patterns, might have radical influences on the child's responses.

Entwisle worked with children aged from four to eleven years. Her main intention was to study language acquisition during these years through the medium of association data. Amongst her findings she concluded:

"The chief finding is that paradigmatic responses - responses matching the form class of the stimulus - increase over the years of middle childhood, but at different rates.... our data suggests that the child first learns what-follows-what, (the phase of syntactic responding) and then what-substitutes-for-what (the phase of paradigmatic responding)."

As Entwisle points out, the type of response given by the child indicates his awareness of rules - for instance, when he gives a paradigmatic associate, he indicates that he knows something of the rules which govern a particular form class. Discussing Miller's (1965) work on language, Entwisle notes that because children have fewer markers than adults they tend to have much broader classes of words, which is no doubt the reason why many more - and more varied - responses are given by younger children to stimulus words. In fact, the younger the child, the more various the associations, even though the vocabulary of the younger child is necessarily smaller than that of the older or adult subject.

What is indicated by all of these studies is a gradual stabilisation of the child's knowledge system. His increasing awareness of rules and constraints governing phenomena affects his approach to, and interpretation of, them. It would seem, in some instances, that stages or phases can be

Entwisle, D. (1966) Word Associations of Young Children. John Hopkins Press P.7.

Miller, G. and McNeill, D. (1965) cited in Entwisle, D. (1966) (above) P.125-6.

marked out and that certain kinds of responses might be expected at different phases or stages. This is a factor which could be of importance in the assessment of children's responses to creativity items of the free association type. Assessment must be made over and against what could be a determining sub-structure of the child's knowledge-system. At first sight, Nelson's (1974) work on categorisation might seem to oppose that of Entwistle's. Working with subjects aged from 4-8 years, and concerned essentially with category membership, Nelson concluded that:

"Considerable variations amongst the categories in size and composition was found by both quantitative indices and qualitative analyses. Age changes occurred primarily in an increase in number of responses given, and these appeared to be related to the increasing articulation and hierarchical expansion of the categories."

Nelson illustrates that the child's categories (membership) are poorer because increasing boundary definitions would seem to be a function of age, whilst Entwistle, employing a free association method observes fewer markers in the younger child's organisation, and wider associations. Both researchers, however, are really concerned with socialisation into categories of some form.

Research into graphic expression reveals similarly that the world of the child is disorganised and subject to distortion. Viktor Lowenfeld (1959) in a study of children's drawings with subjects ranging from 4 to 17 years of age found that in the youngest subjects, the interrelations of things in time and space were subject to no discernible laws. Lowenfeld considers the types of rule-awareness which grow up in the child. The 7-9 year old stage he describes as the "schematic stage" characterised by the discovery of order in space relations. From 9-11 years - the "realism stage" - Lowenfeld describes the child as becoming aware of the concept of overlap (i.e. a tree growing from the ground will partly

Nelson, K. (1974) "Variation in children's concepts by age and category", Ch. Devt. 45. P.577-84.

Lowenfeld, V. (1959) The Nature of Creative Activity.

overlap with the sky). Finally, from 11-13 years, there is the "pseudo-realistic stage" - when the perception of perspective begins to form.

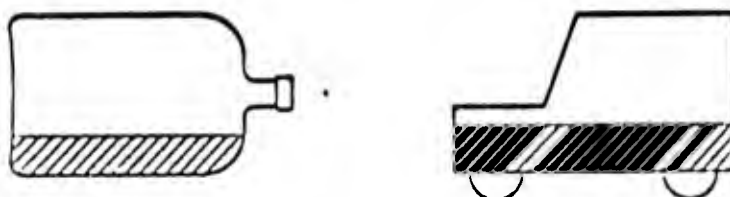
Presentations might well be distorted through assimilation problems. Hermina Sinclair (1974) explains how the child assimilates to his basic knowledge what he has heard or seen. She insists that the child's problem is not in fact one of memory, as the memory load in the tasks set by her was deliberately light, but rather that it is a matter of assimilating on the basis of knowledge and experience. (PLATE 1)

Piaget with Inhelder (1973) in a number of studies on memory, with fellow workers such as Sinclair and Bliss, explains the role of memory and the relationship between memory and understanding. Piaget explains that memory is a mode of knowledge and its special province is the past and the reconstruction of the past. Unlike intelligence, it is not involved in the solution of new problems. Piaget presents some interesting evidence to support the idea that what is remembered is related to what is understood. With Mounoud, Piaget examined memory and causal processes:

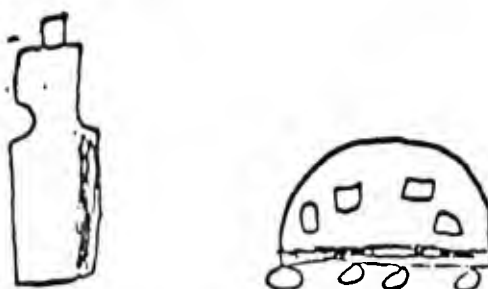
"Now the main question our present experiment is designed to answer is whether the child's remembrance is purely descriptive or whether it is at all times affected by his causal interpretation." (Piaget, 1973)

In this experiment in which the child is asked to provide a static description of the model before him (PLATE 2) and then a description of the model functioning, Piaget and Mounoud concluded that the child remembers chiefly what he has understood.

Sinclair, H. (1974) "From preoperational to concrete thinking and parallel development of symbolisation" in: Piaget in the Classroom. Schwebel & Raph. Piaget, J. and Inhelder, B. (1973) Memory and Intelligence. P.20.

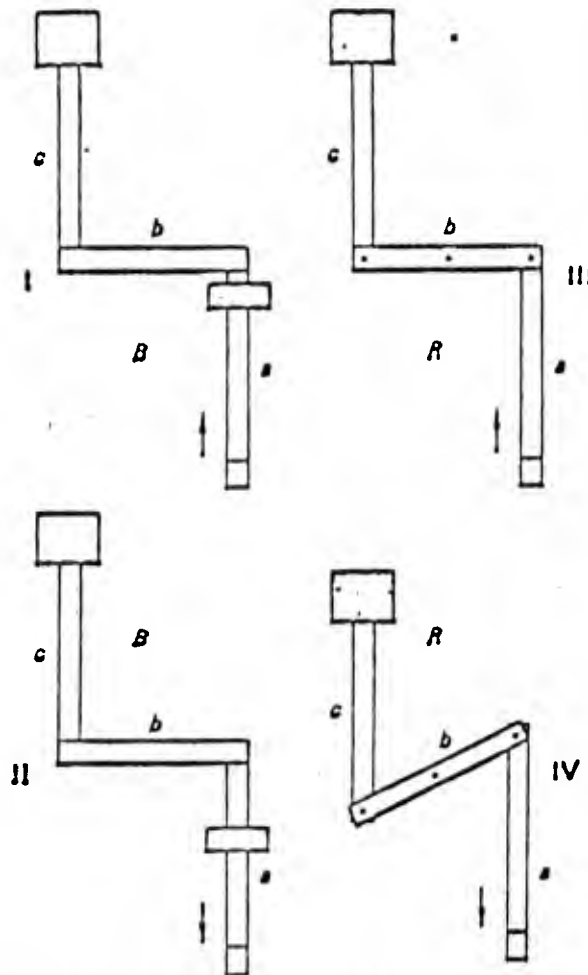
PLATE 1

The picture of the bottle and the toy car as used by Hermina Sinclair. The liquid was coloured red and the car had a red strip to emphasise the horizontal positions of both. The children were asked to draw the objects as they would be when standing in different positions.



a typical attempt by subjects in the 4 - 5 year old age group.

Taken from: From Preoperational to Concrete Thinking & Parallel Development of Symbolisation in: Piaget in The Classroom. Raph. J. & Schwebel M.(Eds) '74.

PLATE 2.

from: Memory and Intelligence. Piaget.J. and
Inhelder. B. '73. pp. 199-211.

In this experiment the subject is provided with the two models shown above - B and R. In their static state the two models resemble each other, but represent two distinct causal mechanisms. Model B is rigid and held in position by a slide. When handle (a) is pushed up, the whole model moves in a vertical direction. Model R is fixed to the board by a central bolt, and its three segments are connected by two screws. When handle (a) is pushed up the segments (b) and (c) move down.

The subject is required to provide:

- a. a static description: "What do we have on this board"
- b. a description of the processes having operated the rods himself.

Piaget then makes an important distinction between memory concerned with the purely descriptive, and that concerned with causal, processes. The distinction is really about whether the subject is simply required to reproduce what he perceives or whether he is called upon to transform or re-structure that material in some way:

"... if memory were confined to recoding, retaining and recalling perceptions, and hence involved no intellectual transformations, then it would rest exclusively on the 'observables'... the observable is the purely descriptive, no doubt associated with an increasingly searching analysis, but never transcending the data." (my underlining) Ibid.

This distinction between the descriptive and the transformative has real implications for creativity as understood here. Comprehension of the essential structures and functions of items and events is necessary, it would seem, for intellectual re-constructions of such, and creative tasks require such re-constructions. This is perhaps interpretable as another Piagetian distinction between passive knowing and active constructing and re-constructing. Like Piaget's second task cited from the above work, Sinclair's (ibid) was likewise concerned with more than the observables and required therefore an understanding of what was being reproduced.

Piaget, however, recognises that memory is not entirely dependent upon comprehension:

"If the memory comprises the entire conservation of the past, and its restoration in the present, there is no reason to think that it must confine itself to those aspects of reality which have been understood; it is quite conceivable that a child, having observed a series of peculiar decantations... may remember the general procedure even though he fails to grasp its purpose." Ibid.

In the second part of this present research, this was in fact shown to be true: children as young as 7 years of age were sometimes capable of remembering and drawing from memory, complex, interrelated forms.

Piaget, J. (1973) Ibid. P.201

Sinclair, H. (1974) Ibid.

Piaget, J. (1973) Ibid. P. 116

However, none of these children showed any real grasp of the structures on subsequent transfer tasks. The purely descriptive, in the sense employed here by Piaget, provides no basis for creative transformations.

Within different descriptive and theoretical systems, support is found for an increase in integration and systematisation with age and development. Russell (1956) noted that the formation of concepts moves along a continuum from simple to complex, from concrete to abstract, from undifferentiated to differentiated, from discrete to organised and from ego-centric to social. The idea of gradual differentiation and refinement of abilities is inherent in Guilford's model of intelligence, differentiation not coming about until early adolescence.

Piaget (1948) has considered the child's growth into a system of rules. In the Moral Judgement of the Child, he discusses the idea of the dawning of a regularity of a physical type:

"from its earliest months the child is bathed in an atmosphere of rules."

But as Piaget is quick to note, the child is coerced into regularity at this point. For any such regularity to develop into rule-consciousness, there has to be, as Durkheim with his deterministic concept of society owned, the idea of obligation (Piaget, *ibid*), which is more than recognition of mere regularity. In his observations of children's games, Piaget notes the child's passage from this stage of mere regularity to a stage of conscious rule-awareness. This passage is, however, "suffered not sought" (Piaget, 1950). Later, when the child has some concept of an external system of rules and of organisation, he will check his

Russell, D. (1956) Children's Thinking.

Piaget, J. (1948) The Moral Judgement of the Child. P.43.

Piaget, J. (1950) The Psychology of Intelligence. P.103.

ideas against this system. Whilst the child's tendency in the ego-centric period is to accept outside rules, his inclination is still to play alone and to ignore such rules for the most part. He next moves to a stage termed "incipient co-operation" where there is an increased awareness of rules to the point, usually, of rigidity. Rules take on an almost sacred nature. The child has moved from a truly ego-centric position where he played in an individual manner with social material to an extreme acceptance of rule-recognition and obligation. A more flexible standpoint is attained at the "codification of rules" stage where the sacred-mystery dimension of rules is minimised, where rules are known to the whole group and indeed generally arise from group consensus and group recognition. There is a mature notion of obligation here, one which is freely undertaken, and where rules are seen as open to change if the group desires to change them. Berger and Luckmann (1969) presented an interesting analysis of socialisation in terms of a dialectical process between objective and subjective reality. Though their focus was upon the social construction of reality (and their inspiration rooted in Marx's notion of man's consciousness as determined by his social being) a parallel could be drawn between this explanation of socialisation and Piaget's explanation, with his notions of assimilation and accommodation. On the matter of rules, and with specific reference to language, Berger and Luckman (1969) point out that:

"In the early stages of socialisation the child is quite incapable of distinguishing between the objectivity of natural phenomena and the objectivity of social formations. To take the most important item of socialisation, language appears to the child as inherent in the nature of things, and he cannot grasp the notion of its conventionality."

Though he attributes less importance to the role of language in socialisation into knowledge, Piaget has noted some interesting patterns of rule awareness in the child's language development (Piaget, 1932). The young child is deficient in what Piaget has termed "adapted information" in his exchanges with others. He is incapable of true criticism or of argument, of true questions and logical answers. This is because he is unaware of, or cannot comprehend, the logic governing such areas. Instead he indulges in what Piaget has termed "monologue", "repetition" and "collective monologue". Piaget argues that the child responds this way because he is cognitively incapable of doing otherwise. Vygotsky (1962) has challenged this point, offering a somewhat different interpretation of ego-centric speech, regarding it as a more deliberate and chosen action. Interesting though the challenge is, it would seem that the term is used so differently by each one as to render the challenge a non-challenge, if it were ever intended directly as such. The ability to be ego-centric in the sense of 'choosing' implies the ability to speak in a socialised manner (Piagetian sense). Piaget defines social speech differently, and perhaps Vygotsky does not take up, to the same degree or from the same standpoint, the notion of developmental inability. In the same work Piaget refers to ego-centrism as an orientation of the mind. More importantly he sees ego-centrism surviving in adults,

"... in all circumstances where they (adults) are still dominated by spontaneous, naive and consequently infantile attitudes." (Ibid)

This is a phenomenon which is quite distinct from behaviour explicable in terms of "decalage" (i.e. development which has not taken place within a specific area - either horizontal or vertical in type), and it is a phenomenon which is to be found in formal operational thinkers too.

Piaget, J. (1932) The Language and Thought of the Child.

Vygotsky, S. (1962) Thought and Language.

The notion of rule-consciousness is bound up with cognitive organisation and the process of structuring reality, for some of this process must involve rule-ability. Bruner has been accused of having a perceptual model which presupposes an adult perceiver (Wohwill, 1969). As one would expect, Piaget as a developmental psychologist has pointed a finger here (Piaget and Morf, 1958). True as this might be, and much as Piaget is concerned to stress the developing structures of the child, his important arrival-point is the adult knower, the mature model, and in the case of both Bruner and Piaget, arrival is characterised by a level of organisation of thought. Both men are also concerned with active construction or representation of reality.

Bruner's stress is on the process dimension - the ways in which the individual comes to conclusions about information, the ways in which he scans, focusses, the strategies which he employs in interpreting and in going beyond the information given. All of these strategies operate within an organisational framework (see Bruner's model - active - iconic - symbolic) and imply the existence of some kind of knowledge organisation.

Categorisation is a way of organising knowledge. It involves rendering discriminably different things equivalent, responding to objects and events in terms of their class membership rather than their uniqueness (Bruner, 1967). Bruner discusses the idea of organisation on a perceptual basis and at a conceptual level, pointing out that one of the principal differences between the two forms of categorisation is the immediacy to experience of the attributes by which their fitness to a

Piaget, J. (1932) Ibid.

Wohwill J. (1969) in: Sigel and Hooper, Logical Thinking in Children. P.475.

Piaget and Morf (1958) in: J.S. Bruner et al, Logique et perception. Etudes d'Epistemologie Genetique. Vol 6. pp 49-116.

Bruner, J. et al (1967) A Study of Thinking.

category is determined. This ability involves learning the criteria which a given culture regards as relevant. It is a matter of finding predictive defining attributes that distinguish exemplars from non-exemplars of the class one seeks to distinguish.

This cultural dimension in the organisation of knowledge could be closely related to the perceptual mode of classifying reality. Commenting on the problems of cultural concepts, Baldwin (1968) points out, with specific reference to the concept of invariance, that invariance of quantity, for instance, is partly a matter of definition. Quantity is simply that aspect of the liquid (or substance) that does remain invariant. What is culturally normative about the invariance is the definition of quantity in such a way that it is independent of location, shape and arrangement. There is no reason at all, according to Baldwin, why these latter factors should not be taken into consideration in a definition of quantity or of some other yet uninvented concept regarding changes in the presentation of amounts of given things. Part of acculturation is learning to ignore what at first strikes as highly relevant, largely because of its pressing perceptual immediacy.

Bruner discusses identity categorisation (Bruner, 1974). This form of categorisation is concerned with classifying a variety of stimuli as forms of the same thing - e.g. the moon is always the moon even when seen from different angles. Now initially the child has identity problems with such issues. Piaget has illustrated this with the problem of the ellipse - i.e. the child at a certain stage shows an inability to recognise flat round objects from an elliptical position. Identity categorisation is a

Baldwin, A. (1968) Theories of Child Development.

Bruner, J. (1974) Beyond the Information Given.

fundamental problem in conceptual organisation. After the actual recognition of such objects (and this could be explained in terms of shape constancy), there comes the process of categorisation which involves learning that objects seen from different angles still merit the same category because of a basic common identity which is culturally agreed upon. The task is always about reducing the complexity and disparity of reality to a state of affairs that gives common identity. Classification on the basis of equivalence is equally concerned with the reduction of complexity, requiring individuals to respond to a set of discriminably different objects as the same kind of thing, or more or less so. The criteria may not be at all visible. The learner-categoriser is likely to operate on faulty criteria from time to time, producing in so doing, 'interesting', perhaps symbolic, relationships and groupings. But distinctions must be made between the hesitations of the novice and the deliberate, novel categorisations of a mature and flexible knower. In spite of persisting faults, the child has reached an important point in terms of the organisation of knowledge when he realises that there are criteria for classifying and ordering phenomena. This realisation implies an awareness of organisation itself.

The passage of the knower is described by Piaget in adaptive terms. His central concept of accommodation implies that the environment does bring about changes in cognitive structures, though he is cautious about the weighting he gives to this dimension, referring to it more as the "American Question". Bruner (1966) makes the point that:

"mental growth is in very considerable measure dependent upon growth from the outside in... a mastering of techniques that are embodied in the culture and that are passed on in a contingent dialogue by agents of the culture."

Bruner, J. (1966) "On cognitive growth" in: Studies in Cognitive Growth, Bruner, J. et al. P.6.

Knowing involves perceiving and organising - that is recognising, naming, categorising and relating, and such activities take place within a cultural framework. The knower requires a relationship with the agents of his culture to develop the world view of his neighbours, he also requires a certain level of transforming interaction to develop and effect changes in his cognitive structures.

An understanding of Piaget's concept of 'operation' is crucial to this study and is central to many of its assumptions:

"To understand the development of knowledge we must start with an idea which seems central to me - the idea of an operation... an operation is the essence of knowledge; it is an interiorised action which modifies the object of knowledge." (1972)

Piaget continues to elaborate on this central concept, explaining that an operation is not isolated. An operation is always linked to other operations and as a result, it is always part of a total structure (ibid). As a developmental psychologist, Piaget's main task is about understanding and explaining the development and formation of such structures.

The idea of operation is further important because of its implications for the idea of consciousness of knowledge and consciousness of one's actions upon phenomena. The identity, the completeness of an operational act allows it to be repeated, to be approached from other angles, to be knowingly modified, and most important it can be observed from an objective standpoint by the knower. The formation of formal operations and the consciousness that such a development brings about, allows the thinker or doer to regard his own activity as an object for reflection.

Piaget, J. (1972) "Development and learning" in: Readings in Child Behaviour & Development. Lavatelli C.S. & Stendler. F. (Eds) P.185.

The foundations of this type of regularity, this patterning and this structural wholeness are to be found in earlier non-operational activities, which at an earlier level of development had their own coherence and their own patterning, but were limited by immediacy and ego-centricity of an extreme type. Early schemas had their form, thus earning them the title. The child in the 4th sub-stage of development attains combinations of schemas and Piaget talks of 'sensori-motor concepts'. However, it is only around the 5th sub-stage (c. 2nd year of age) that the child attains object-constancy. Here, when the object is:

"sought in accord with its successive displacements, the group is really made objective and the combinativity of displacements, their reversibility and conservation of position are achieved."
(Piaget, 1967)

Whilst sensori-motor intelligence lies at the source of thought and continues to affect it throughout life, it is important to stress its limitations. Piaget refers to sensori-motor intelligence as functioning like a slow-motion film where the pictures are seen in succession, but where there is no real fusion or relationship drawn. Because of this, there can be no continuous vision, which is essential if one is to understand the wholeness and identity of acts and events. This type of pre-operational intelligence can lead only to immediate understanding and satisfaction. Any knowing must be tied to the objects of knowledge themselves and not to knowledge and an objective understanding of the knowledge system:

"Thought alone breaks away from these short distances and physical pathways." (Ibid)

In brief, the conscious reflective dimension is absent from this early type of knowing.

Piaget sees that at a given moment in development, intuitive relations of a given system are 'grouped'. He has also offered criteria by which groupings are to be recognised. Operational ability exists at two levels: concrete, and formal or abstract. Cognizance of the characteristics of these two levels is essential to an understanding of creativity as defined here, for it is argued that full creativity is not possible in the absence of formal operational ability. Creativity in its mature state requires a high level of consciousness: consciousness of the identity of phenomena and consciousness of the transformations brought about on such phenomena. Creative thinking is therefore highly reflective. The creative knower, conscious of his culture's way of organising reality, has sufficient understanding of rules and relationships to be able to transform such relationships and inspire new groupings and new identities. Piaget uses the term 'grouping' to describe the structures of the concrete operational period. Whilst they have some properties of a 'group' such as reversibility, associativity and completeness, concrete operations do not form a 'group' as such. The term 'group' is reserved for those structures in the formal operational period, (Baldwin, 1968) (Flavell, 1974). Nine basic groupings exist within this period. They are all concerned with ways of organising phenomena and of understanding events in relation. They are all about the concrete, the immediate, the non-hypothetical.

Piaget (1967) notes several new abilities arising from these groupings. These abilities allow a certain level of reflection and at this point, the possibility of a "concrete creativity" comes into being. The development of creative structuring of knowledge at this stage is a direct result of factors such as:

Baldwin, A. (1968) Theories of Child Development.

Flavell, J.H. (1974) The Developmental Psychology of Jean Piaget.

Piaget, J. (1967) The Psychology of Intelligence.

1. The possibility of the combination of successive actions.
2. Reversibility.
3. The fact that the same point or conclusion can now be reached by more than one path.
4. The individual is now capable of returning to the starting point of an action and knows that the starting point can be found to be unchanged.
5. When the same action is repeated it either adds nothing to itself or else is a new action with a cumulative effect. (Ibid)

Such factors are required for early creative structurings. There is a further essential factor - that of needing to know that one is departing from recognised paths.

The point at issue throughout this discussion, is that the child is making constant attempts to arrive at a level of cognitive organisation which will give him some control over phenomenon, by means of his own structurings of it. Until he can organise it to some degree, it can never become an object of reflection, never be considered, and inferences not drawn. This kind of problem is illustrated in recent work by Flavell, J.H. and Drozda, J.G. (1975). They were interested in the "concept of a critical search area". They employed a cartoon figure which lost a toy walking through its house. Working with subjects aged 5-10 years, they found that it was not until the age of about 7 or 8 that the children readily made the inference that the critical area was the only reasonable place to search for the lost toy. They concluded that the ability to make such organisations might be explained in terms of:

"... a concrete-operational conception of temporal order."

Often, Piagetian stages are conceived of in terms of a description of the state of the child. It is important to stress equally, that they must also be descriptions of the child's organisation of reality itself. This idea of the ordering of reality is illustrated in Potter's work (1966) on perceptual recognition. Essentially, Potter's subjects were required to recognise objects which were presented with fewer distortions and more cues on each presentation. Potter noted that with age, subjects ceased to guess but checked out hypotheses against data. A growth in cognitive organisation made possible the maximum use of information. In a somewhat different task Mosher, A. and Hornsby, J. (1966) required subjects to ask questions in order to arrive at conclusions. They found that with development, the child attains a more organised and constrained strategy for using information.

With the advent of formal operational thought comes a reflecting upon operations and a consequent second-degree grouping of operations. The formal operational thinker is capable of the hypothetical and in Piaget's words, of: "delighting especially in what is not" (Ibid, 1967). Thought is freed from the concrete and immediate and the world of the possible becomes available for construction and re-construction.

The notion of consciousness of one's structuring of the universe is important to this discussion of creativity. It is related to a realisation of identity of phenomena, to reversibility and to the dawning of self-awareness, and of self as structurer and intervener. References to this dimension of development are scattered throughout Piaget's works. Commenting on children's definitions, he writes (1928):

Potter, M.C. (1966) "On Perceptual Recognition" in: Bruner, J. Studies in Cognitive Growth.

Mosher, A. and Hornsby, J. (1966) "On Asking Questions" in: Bruner, J. Ibid. Piaget, J. (1967) Ibid. P.148.

Piaget, J. (1928) Judgement and Reasoning in the Child. P.114

"... children's definitions are interesting but they are not easy to interpret, for all definition is conscious realisation."

Ego-centricity necessarily involves a certain lack of such consciousness. This means that whilst the young child might offer 'interesting' interpretations of words and events, the label 'interesting' (even creative) is one which is placed on the event or action by the observing adult perceiver, who is sufficiently cognitively mature to identify the process itself. The actual thought processes of the child at that time are governed by ego-centric characteristics and the relations or distortions of reality stemming from these. Because of this, childish thought lacks logical necessity and genuine implication (ibid).

In his detailed examinations of childish thought, in numerous contexts and with varied content, Piaget illustrates types of distortions of relationship and logical implication. He discusses the concept of 'juxtapositioning' - which implies a non-understanding of objective logical relations. The poor use of words such as 'because' for instance, reveals a poor grasp of relations - for example: "The sun does not fall down because it is hot..." (ibid). It may well be that there is a private, symbolic logic, sensible to the child, but it is not part of the commonly agreed pattern of relations and explanations.

Piaget (ibid) uses the term 'syncretism' to describe the way the young child has a spontaneous tendency to take things in by means of a comprehensive act of perception instead of by the detection of, and attention to, detail. The child finds immediately and without any real analysis, analogies between words or objects that have nothing to do with each other. He manages to find some 'reason' for every chance event. Commenting on

syncretism and juxtapositioning, Piaget (1928) says:

"Syncretism is therefore an excess of relating, whilst juxtapositioning exhibits a deficiency in the same function."

In Piaget's framework, lack of consciousness is explicable in terms of the balance of relations between the concepts of assimilation and accommodation. When solidarity is established between these two dynamic features:

"... thought becomes increasingly capable of reversibility. For the capacity of leaving one's own viewpoint and entering into that of other people robs assimilation of its deforming character and forces it to respect the objectivity of data."
(Ibid)

This same theme of confusion and distortion and its relationship to a lack of consciousness is taken up in other investigations of Piaget (1954). He comments on the significance of self-consciousness for the child's own behaviour:

"With increasing differentiation and equilibrium of assimilation and accommodation during the sensori-motor period, there comes a development of great significance for intelligence. There is a process of objectification of external reality and the development of the awareness of the self." (1954).

This state has real implications for imagination, to be distinguished from phantasy, for without the ability to measure events against external realities, imagination is not a possibility:

"... in reality the child has no imagination, and what we ascribe to him as such is no more than a lack of coherence and still more subjective assimilation as shown by his transpositions." (Piaget, 1962)

Ruth Griffiths (1965) has reiterated this idea of confusion in the young child's mind, but she fails to make a clear distinction between phantasy and imagination in the way that both Piaget and M. Lowenfeld do.

Piaget, J. (1928) Judgement and Reasoning in the Child. P.4 and P.180

Piaget, J. (1954) The Construction of Reality in the Child.

Piaget, J. (1962) Play Dreams and Imitation in Childhood. P.30.

Griffiths, R. (1965) A Study of Imagination in Early Childhood.

Within Lowenfeld's (1969) analytic framework, imagination is defined as having a definite relationship with reality, whereas phantasy is controlled by the wishes and desires of the child. This matter of imagination will be dealt with in greater detail in the following chapter and then in relation to symbolic behaviour. The point at issue here is the tenuous relationship between the world of the child (characterised by phantasy) and the 'objective world'.

To understand what Piaget intends by 'image' it is necessary to remember that he regards knowledge as an assimilative process and that "objectivity is the result of progressive conquest" (1971). He rejects the 'knowledge-as-copy' hypothesis in favour of the view that the object can be known only by being conceptualised. Consequently, any mental re-construction of an object (reproductive images) and any mental explorations of, or adjustments to, objects (anticipatory images) require an operational framework. But the image has a role to play too:

"The image ensures finer analysis of 'states' and even aids figural anticipation of 'transformations'... this makes the image an indispensable auxiliary in the functioning of the very dynamism of thought - but only as long as it remains consistently subordinate to such operational dynamism, which it cannot replace, and which it can only express symbolically with degrees of distortion or fidelity according to circumstances."
(1971)

Imaginative behaviour therefore has no essential role in providing structures for intellectual development, but it is as Piaget terms it an 'indispensable auxiliary' to thought.

As might be expected, the stage notion is reflected in Piaget's treatment of imagination. The most critical step is that from pre-operational to operational thought:

Lowenfeld, M. (1969) Play in Childhood.

Piaget, J. and Inhelder, B. (1971) Mental Imagery in the Child. P.390.

"Generally speaking pre-operational thought may be thought of as a system of notions within which figurative treatment of states takes precedence over comprehension of transformations. Consequently at this level images govern thought, while the situation is reversed at the operational level." (1971)

Here, no doubt, is the point of distinction, for Piaget, between imagination and phantasy. Operational ability is essential for interpretation of reality or as Piaget puts it:

"The operations carry out the transformation; the image represents them." (Ibid, P.228)

Sarbin and Juhasz (1970) are critical of Piaget's explanation of imagination - more precisely its genesis - in terms of "deferred imitation" of that which is signified, suggesting that it is adequate only up to a point:

"This analysis works well enough for tasks which call for 'visual' descriptions, which Piaget, like so many others employed almost exclusively, but like the pictures in the mind analogy, it collapses when applied to the somasthetic senses... when one tries to consider 'deferredly imitating' the tastes of tutti-frutti ice cream or the fragrance of a freshly cut rose."

Such criticism would seem to suggest that Sarbin and Juhasz have failed to take account of Piaget's explanation of knowledge, and in particular his idea that an image is fundamentally symbolic. According to knowledge and experience, one will construct, adequately or otherwise, a mental image - a symbol - of what has been experienced - or of what could be experienced. Sarbin is perhaps a little too concrete in criticising what Piaget is supposed to be about. It is just as possible to have a mental construct of a taste or smell as it is to have a mental construct of a pencil. In all instances, we are talking about symbolic approximations to 'reality'.

Piaget, J. and Inhelder, B. (1971) Ibid. P.197.

Sarbin, T. and Juhasz, J.B. (1970) "Toward a theory of imagination", J. of Personality. 38, pp 52-72.

Sarbin and Juhasz propose their own explanation of the development of imagination which is based on the notion of imitation, but with modifications. Essentially, imagination is explained as 'muted role-taking', an explanation which has some of the difficulties of behavioural explanations of 'inner speech' as language gone underground via whispering!

Piaget is saying once again that imagination requires certain cognitive structures by which to function. Imagination is crucial to mature creative thought, for without it, subjects would be tied to mental explorations only of what is known. Formal operational thought brings the individual to the stage where he can be independent of concrete props to thought; imagination, essentially about symbolic representation, is a way of representing operational thought.

Before the possibility then, of even an elementary type of creativity, the child is in need of some operational ability. Intuitive thought involves a direct relationship between a schema of internalised action and the perception of objects, and can only result in configurations centred on this relationship. Intuitive thought is still essentially phenomenalist because:

"... it copies the outlines of reality without correcting them, and ego-centric because it is constantly related to present action." Piaget, 1967.

Intuitive thought is no basis for creative behaviour.

The dynamics of Piaget's model are of importance here, for they raise the whole matter of the possibility of training for, or accelerating, cognitive organisation. Assimilation and accommodation are the

dynamic agents of change. Piaget (1972) makes a strong distinction between learning and development. He describes the development of knowledge as:

"... a spontaneous process, tied to the whole process of embryogenesis. Embryogenesis concerns the development of the body, but it concerns as well the development of the nervous system, and the development of mental function..."

Learning, on the other hand, has an almost contrived element for Piaget. It is seen as tied to specific situations or events, with little possibility of generalisation:

"In general learning is provoked by situations - provoked by a psychological experimenter, or by a teacher with respect to some didactic point; or by an external situation. It is provoked in general as opposed to being spontaneous. In addition it is a limited process, limited to a single problem or a single structure." (Ibid.)

Piaget cannot accept the notion that development is the sum total of a number of discrete learning experiences summed up to signify the individual's ability. At the same time, he does not deny the role of all experience or experiences in the formation of cognitive structures. This immediately raises the question of what is to be defined as experience to the experiencing individual. Piaget agrees, moreover, that operational structures can be learned if the 'learning' is based on simpler more elementary structures; in other words, if there is a natural development of structures. Further, his explanation of growth is quite definitely not a maturational one. He himself argues the inadequacy of such an explanation, citing work carried out on African peoples to illustrate the fact that the order of the succession of the stages remains constant but that the chronological ages of these stages vary a great deal (ibid).

Piaget, J. (1972) "Development and learning" in: Readings in Child Behaviour & Development. Iavatelli. C. & Stendler. F. (Eds.) P.38.

If we are to employ Piaget's categories of 'experience' (and he is no Existentialist!) we must talk of 'physical experience' and of 'logical mathematical experience'. The former always involves:

"acting upon objects and drawing some knowledge about the objects by abstraction from the objects... this is experience in the usual sense of the term, in the sense used by empiricists." (Ibid, P. 41)

For Piaget, the more important type of experience in terms of transformation of structures is the logical-mathematical type of experience. Here:

"knowledge is not drawn from the objects but is drawn by the actions effected upon the objects. This is not the same thing. When one acts upon objects the objects are indeed there, but there is also the set of actions which modify the objects." (Ibid, P.41.)

Piaget goes on to give an example of this latter type of experience involving the discovery of a property of the action of ordering by a child of about four or five years of age. The child was playing with pebbles, and began 'ordering' them. The child discovered: "a property of actions and not a property of pebbles." (Ibid).

This kind of experience is both reflective and transforming. It is crucial to the transformation and development of cognitive structures. An important question is - how do such experiences take place? Can one structure for them? How does one become a Brunerian 'interpreter' or 'translator' (Bruner, 1968)? It is not easy to contrive situations leading to this transforming type of logical-mathematical experience, which involves bringing the ordering effects in the child's consciousness. This may well, of course, be more of a comment on our inabilities as 'translators', or on the problem of trapping learning moments in a child's experience, rather than an indication of the pointlessness of training

Piaget, J. (1972) Ibid. P.41.

Bruner, J. (1968) Towards a Theory of Instruction.

endeavours. Some training attempts have met with apparent success, for instance the work of Kingsley and Hall (1967) and their use of learning sets based on Gagné's work. In their programme, their subjects were not passive recipients, but were required to structure meaningfully, which might account for some degree of generalisation which resulted.

However, there is the deepest caution to be found in Piaget concerning training attempts generally. His concern is not with an empirical surface learning, but with a deeper logic, not always 'visible', and which cannot necessarily be made to be so, for it concerns aspects such as relationships and organisation, and such dimensions are usually implied, or agreed implicitly.

Discussing the conservation of substance, for instance, he writes:

"No experiment, no experience, can show the child that there is the same amount of substance. He can weigh the ball and that would lead to the conservation of weight. He can immerse it in water and that would lead to the conservation of volume. But the notion of substance is attained before either weight or volume. This conservation of substance is simply a logical necessity (my underlining)... even though no experience could have led to this notion." (Piaget, *ibid*).

This is an extreme position and one which is perhaps not always consistent with Piaget's own thinking. Without doubt, with logical-mathematical experience there is the problem of ever knowing when - if at all - a situation or structured learning situation is able to bring about understanding in terms of logical necessity. At the same time, adaptation (a key Piagetian concept) takes place within cultural contexts, and whilst we cannot guarantee the influence of everyday contexts upon cognitive structures, neither can we deny effects of general adaptational experiences, most of which we never attempt to define or measure. Piaget has obviously admitted the transforming effects of the general environment:

Kingsley and Hall (1967) "Training conservation through the use of learning sets", Ch. Devt. 38, 1111-1126
 Piaget, J. (1972) *Ibid.* P. 40.

"Society ... changes the very structure of the individual, because it not only compels him to recognise facts, but also provides him with a ready made system of signs which modify his thought." (1967)

The aim of those concerned with learning is surely to trap these moments of cognitive change and to re-construct them for experimental and acceleration purposes. There is something analogous to the study of chromosomal patterns here. Such patterns are usually most clearly perceived at moments of cell division and such moments have to be trapped. Those concerned with 'acceleration', and understanding in the Piagetian sense, have yet, it would seem, to isolate and study instances of structural transformations.

For the most fundamental explanation of change in the organism, we are asked to return to the organism itself. Furth (1969), explaining this point, says:

"When asked to name the chief determinants of change, why and how a structure changes, Piaget answers that the fact and process of change still find their ultimate explanation in the basic notion of a living organism with which we started."

Here we have the idea of self-perpetuating cognitive structures which because of their very nature will function and will continue to function. A further basic explanatory assumption of Piaget's is that of a particular regulating force - namely equilibrium. As defined by Piaget, it means:

"... a fundamental factor in development. I use this term in the sense in which it is used in cybernetics, that is in the sense of processes which feedback and which feedforward, of processes which regulate themselves by progressive compensations of systems." (Piaget, 1972, *ibid*)

If the development of intelligence is explicable in terms of adaptation, it is important that the developing individual be challenged, and

Piaget, J. (1967) The Psychology of Intelligence. P.156

Furth, H. (1969) Piaget and Knowledge. P.18

Piaget, J. (1972) "Development and learning" in: Readings in Child Behaviour & Development. Iavatelli. C. & Stendler.F.(Eds) P.42.

initially even coerced, into adaptation. Piaget speaks of coercion (Piaget, 1928). Hans Furth (University of London, Institute of Education Lecture, 1974) spoke of the need to provide "challenging situations" to bring about what might be termed: "directed adaptation". Piaget's request is for active construction and in one sense no growth can be based solely on experience (Tanner and Inhelder, 1956). Placed within another philosophy, in another framework, that of personal construct theory, one might well cite George Kelly (1963):

"... it is not what happens around him that makes a man experienced; it is the successive construing and reconstruing of what happens... that enriches the experience of his life."

As will be discussed more fully in the second section of this research, a problem in studies of learning and of development is that of really understanding "inside" mechanisms and processes. Changes in external behaviour are not difficult to note; understanding the internal cognitive mechanisms assumed to be responsible for such changes is more difficult. Piaget's theory has some such difficulties, some of which must stem from his concepts. The notions of assimilation and accommodation, for instance, present certain problems: we are required to assume their operation or existence, make inferences about these very abstract structures. Bryant makes comment on this matter:

"It is very easy to show that the most direct experimental evidence offered for any theory about child development is always about what the development changes are and not about their causes... It is also true of Piaget's theory. Take for example the idea of a pair of complementary mechanisms, assimilation and accommodation... These are interesting ideas, but very general, and as such difficult to pin down in any experiment. Not surprisingly, Piaget does not offer any direct experimental evidence for assimilation and accommodation." (1974)

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- Tanner, J. and Inhelder, B. (1956) Discussions in Child Development, Vol IV.
 Kelly, G. (1963) A Theory of Personality: The Psychology of Personal Constructs. P.73.
 Bryant, P. (1974) Perception and Understanding in Young Children. P.178

This kind of comment has been directed more extensively by Wohwill (1969) who has accused Piaget of employing mentalistic terms and of constructing a conceptual apparatus of schemas, operations, centrations, etc, which appear to lack direct empirical reference. On this issue, Piaget must be as guilty as Freud whose concepts of psychic energy, for instance, seem even less available to empirical scrutiny.

In this study of creative thought, a further Piagetian assumption is that the child's creative behaviour will pass through defined stages. Such behaviours will be dependent upon his general cognitive development, and his creative responses should be distinguished by different characteristics at different stages.

Flavell (1963) offers a very adequate definition of what is intended by stage:

"Granted that a developmental series is amenable to stage description, the stages abstracted must possess certain properties. First they must emerge in development in an unchanging and constant order or sequence: stage A must, by this criterion, appear in every child before stage B occurs. If the behaviours which define the two stages do not occur in a constant ontogenetic sequence, it is erroneous to speak of them as stages. Although sequence is taken as invariant, the age at which a given stage appears may of course vary considerably."

In his discussions of stage-development, Piaget has been accused of employing a highly idealised model of adult thought (Wohwill, 1969). The accusation is perhaps overstated, for whilst Piaget's model might seem to imply this, in practice he allows for variations by means of "decalage", both "horizontal" and "vertical" in kind (see notes 1 and 2 below). When he talks of stage progression therefore, it is not without recognition of what might be termed 'uneven development'.

Wohwill, J.F. (1969) "From perception to inference" in: Logical Thinking in Children, Sigel & Hooper. Pp472-93 and P.481.

Flavell, J. (1963) The Developmental Psychology of Jean Piaget. P.19

1. Horizontal = when a cognitive structure characteristic of a given level can first be applied to task X but not to task Y.
 2. Vertical = refers to the case where the repetition occurs at a distinctly different level of functioning, rather than within the same level.
- Flavell, *ibid.* (adapted from Flavell, 1963, P.22)

With each stage there is an initial preparatory period where structures are in process of formation. Because of the formative period, there is, prior to the appearance of a stage, a time of instability and disorganisation of structures. There follows upon this, a point of stage achievement and of general stabilisation:

"As will be seen, the concept of intellectual development as a movement from structural disequilibrium to structural equilibrium, repeating itself at ever higher levels of functioning, is a central concept for Piaget." Flavell (ibid)

The three main types of structures as described by Piaget are: the sensori-motor group structures; concrete operation "groupement" structures; combined group and lattice structures. Structures defining earlier stages are incorporated into those of subsequent stages.

An attempt has been made so far to look at the 'knower' and his early developmental state, to examine his ways of organising and of explaining phenomena, and to attempt to explain this behaviour largely in Piagetian terms. The major assumption is that creative organisation of phenomena must follow these same routes, for here, creative thought is seen, not as a separate intellectual mode, but as one which is closely bound up with the development of intelligence. The structures required for intelligent functioning are essential to creative functioning and both types of functioning take place within a cultural context. Interaction with the environment contributes towards the kind of active experience required for the formation of structures. However, this same experience can encourage the individual to accept a particular "world view". And so the development of creativity takes place within tension; on the one hand, there is need for stable, logical structures, on the other, an ability to venture beyond known ways of interpreting and of organising reality.

Solley and Murphy (1957) make the point that:

"Except in the new born, there is always as a result of past experience, some anticipation of what a given situation may portend; every situation is somewhat like the previous situation which had implications for the organism."

Earlier, William James (1890) had made this point in terms of the selective nature of perception. James was strong in his proclamation of the chaos surrounding the world of the infant; stimuli without selection would continue to lack meaning. Experience is therefore what the individual decides to attend to; there is, in consequence, much which never reaches the individual's experience.

There arise, then, factors such as expectation and set, and the idea that we begin to be socialised into a particular knowledge of our world. The Whorfian hypothesis of linguistic determinism is one explanation of this kind of socialisation. Piaget himself has agreed that: "Society provides (the child) with a ready made system of signs which modify his thought" (1967). Maccoby and Modiano (1967) have maintained that the "manner in which a child goes about abstracting equivalence should reflect the nature of his society." So in general and in specific matters cultural influences would seem to be at work affecting interpretations of reality. It is anticipated, because of the development of expectation and set in children, that at certain stages, they will have difficulty with creative type problems or questions, for directed by their own particular set, of which they are unaware because of their own lack of objectivity, and being rule-conscious citizens, they will tend towards rule-bound, cultural interpretations.

Solley, C.M. and Murphy, G. (1957) "Learning to perceive as we wish to perceive". Menninger.Clinic.Bull. 21. 225-237.

James, W. (1890) Principles of Psychology, Vol 1.

Piaget, J. (1967) The Psychology of Intelligence.

Maccoby, M. and Modiano, N. (1967) "On culture and equivalence" in: Studies in Cognitive Growth, Bruner, Olver, Greenfield.

Pronko, Ebert, et al (1966) give support to this notion. Bruner (1967) speaks of the anticipatory nature of cognitive activity and the effects of such anticipation.

There is the whole problem of how, in the light of experiences to facilitate creativity, one might overcome such deterministic factors. Solley and Murphy (1960) point out that there is clinical evidence to suggest that once a perceptual set has been developed it resists modification or replacement. Martin Scheerer (1963), using a Gestalt frame of reference, discusses the problem of habituation in problem-solving and the matter of re-structuring. The Gestalt notion of 'insight' is seen as stemming from a re-structuring of the situation or problem, though there is still the prior question of what brings about such a re-structuring.

Solley and Murphy (ibid) talk about competition amongst the various perceptual tendencies and the fact that this competition is eventually solved by the establishment of a culturally based priority-system. Creative behaviour could be seen in terms of the establishment of a new priority-system.

Vernon, commenting upon Bartlett's idea of schema as a mode of organising thought, talks of schema as:

"persistent, deep-rooted and well organised classifications of ways of perceiving, thinking and behaving..." (1966)

He notes that each individual builds up his own schemata in accordance with his own personal life experiences and the interests which have led him to seek such experiences.

Pronko, M., Ebert, R. et al (1966) "A critical review of perception theories" in: Perceptual Development in Children. Kidd & Rivoire.

Bruner, J. (1967) A Study of Thinking.

Scheerer, M. (1963) Problem Solving. Scientific Amer.

Vernon, M.D. (1966) "Perception in relation to cognition" in: Perceptual Development in Children. Kidd & Rivoire. Pp 389-391.

Solley, M. and Murphy, P. (1960) Development of the Perceptual World.

The effects of set on perception are subject to more than one explanation. Haber (1970) explains that at least two basic and dissimilar explanations have been put forward. One, places the locus of the effect of set in the perceptual system itself, and set is regarded as occurring as the object is being viewed. Alternatively, it is argued that set has no effect upon perception itself, but only on some aspects of the memory trace.

Bruner (1964, reviewed by Haber) argues that perceptual experience is an outcome of categorisation. In other words, an object is only adequately perceived after it has been classified. Haber is quick to point out that Bruner's explanation contains serious theoretical weaknesses, for such an explanation would surely prevent the perceiver from perceiving the 'novel' which he could hardly categorise correctly in advance. Such an explanation would have serious implications for creativity.

A critical issue for those concerned with new thought-patterns, new ways of perceiving and interpreting, is that of attempting to overcome set by some means.

Witkin et al (1962) concluded that children tend to be more field dependent than adults and that such dependency diminished with age. Reese (1963) concluded that formation of set to expect a particular figure does not occur in children to the same extent as in adults. He found that when children aged from four to eight years were shown the ambiguous rat/profile figure (after Bugelski) preceded by drawings of animals or faces, only those aged seven years onwards showed the effects

Haber, N. (1970) "The nature and effect of set on perception" in: Contemporary Theory & Research in Visual Perception. Haber N.

Bruner, J. (1957) "On perceptual readiness", Psy.Rev. 64. 123-204.

Witkin, H., Goodenough, F. et al (1962) Psychological Differentiation: Studies of Development.

Reese, H.W. (1963) "Perceptual set in young children", Ch. Devt. 34. 151.

of set in subsequent judgements. It might seem, therefore, that the perceptual organisation tendencies of young children lack a level of organisation required to make meaningful relations to previous experiences.

With adults, however, it would seem that it might be possible to create expectations through the formation of general schemata (Vernon, 1970) which relate to the situation and which govern a variety of specific instances. Luchins and Luchins (1955), for instance, found that ambiguous stimuli were more accurately perceived when they were preceded by other ambiguous stimuli, than after presentation of non-ambiguous stimuli.

Bruner and Postman (1949) attempted to manipulate set, but found a high degree of resistance on the part of perceivers when expectations were challenged:

"When such expectations are violated by the environment, the perceiver's behaviour can be described as resistant to the recognition of the unexpected or incongruous... Among the perceptual process which implement this resistance are (1) the dominance of one principle of organisation which prevents the appearance of incongruity and (2) a form of 'partial assimilation to expectancy' which we have called compromise."

Such works speak of the potency of set and whilst Luchins et al (ibid) seemed to have had some degree of success in terms of facilitation - or preparation for perceiving, their work is tied to a limited and very specific input in a given situation, whereas perception and interpretation of reality is an ongoing process, vast and difficult to monitor.

With regard to creativity, it would seem that education for this must concern itself with the formation of general schemata (Vernon, ibid) - with perceptual attitudes that are disposed to perceiving and interpreting reality in more varied ways.

Vernon, M.D. (1970) Perception through Experience.

Luchins and Luchins (1955) Cited in Vernon (ibid).

Bruner, J. and Postman, L. (1949) "On the perception of incongruity" reprinted in Experiments in Visual Perception, Vernon, M.D. (1966) pp 285-92.

This second chapter has attempted to examine the ways in which knowledge is organised. Knowledge has to be understood within the context of the culture in which it is socialised and transmitted. Attention must also be given to the cognitive state of the knower, for an adequate study of the organisation of knowledge requires some analysis of the interactive process of adjustment between the developing knower and the socialising context. If creativity is about the reconstruction of reality, it must be studied in relation to culturally accepted constructions, for reconstructions are dependent upon initial constructions. This dependence poses problems. A cognitively mature individual is well able to interpret reality through the eyes of his culture, at the same time the stability of his cognitive system can make him less capable of novel constructions of reality. It is for this reason that much of the training for fluency in creativity has attempted to overcome the problem of 'set'. Set is an inevitable concomitant of cognitive stability and cognitive stability is essential to mature transformations of reality. Socialisation for creativity must therefore concern itself with this point of conflict - namely the dependence of what might be termed divergent constructions of reality upon more convergent and culturally acknowledged constructions.

Chapter 3

APPROACHES TO CREATIVITY

"Not only all thought, but all cognitive and motor activity, from perception and habit to conceptual and reflective thought, consists in linking meanings, and all meaning implies a relation between a significant and a signified reality..." Piaget (1950)

True creative thought requires a certain degree of cognitive maturity. It involves the ability to recognise normative modes of signifying and of linking meanings, and the ability to depart from normative categories to more subjective and symbolic types. It is a dimension of cognitive ability inseparably related to Piaget's concept of intelligence. In its final stage, based on formal operational structures, creativity is highly reflective in nature.

Various notions have been examined under the label of creativity. These different concepts have obviously led to varied attempts at assessment, and differing ideas with regard to the facilitation of creativity by means of training programmes.

Shouksmith (1970) points out that a clear definition of what is a creative product has not yet emerged. His is a useful comment, for apart from highlighting the confusion surrounding the concept, it reminds one of the distinction between creative process, as opposed to creative product, which needs to be made. Guilford (1965) comments fully on this distinction:

"First it is necessary to make a distinction between creativity as such, and creative productivity. An individual may have all the necessary attributes of a creative person, yet his creative output is not very great. Secondly, from the point of view of scientific psychology, creative productivity does not necessarily mean the output of socially useful or desirable products... the scientist must regard inventions and clever ideas as being creative productions regardless of their value."

Piaget, J. (1950) The Psychology of Intelligence. P.124

Shouksmith, (1970) Intelligence, Creativity and Cognitive Style.

Guilford, J.P. (1965) "A psychometric approach to creativity" in:

Creativity in Childhood & Adolescence, Orthopsychiatric Assoc. Symposium.

This standpoint is accepted in this study, and the concern here is with process and ability rather than with output or product. Guilford's idea is not in accord with that of Cyril Burt (1962), who, within the British tradition, has confined the concept of creativity to useful creative activities, with general intelligence being an essential component. Burt pointed out that with the exception of Spearman, the majority of British investigators have, in their research, isolated a factor termed 'productive' as distinct from 'reproductive' imagination.

The question of what is to be deemed useful is a difficult one. This study assumes that it is possible to recognise and evaluate some of the abilities and strategies involved in cognitive deviance, and that such abilities and strategies could lead to 'products' labelled creative; however, the labelling process is a highly subjective one, dependent upon cultural evaluation. There is no attempt therefore to define creative 'products'. Such attempts, it is believed, would be concerned with cultural approval and evaluation rather than with the nature and essence of creative behaviour.

McKinnon (1962) spoke of creativity as involving an idea or response that is novel or at the very least, statistically infrequent. Mackworth (1965) too has stressed the notion of originality, making an interesting distinction between persons whom he describes as 'problem-solvers' and those whom he sees as 'problem-finders'. The latter have a great deal to contribute to society for they have the ability to throw up new ideas, to re-structure reality and to view it in a new, to-be-solved light.

Burt, C. (1962) "Critical notice: the psychology of creative ability", Br. J. of Ed. Psy. Vol 32. pp 292-8.

McKinnon, D. (1962) "The nature and nurture of creative talent", Amer. Psy. 17, pp 484-95.

Mackworth, N.A. (1965) "Originality". Amer. Psychol. 20. pp 51-66.

Wertheimer (1958), working within a different theoretical frame of reference and employing concepts such as vectors, structural determinism and re-structuring, all derived from the Gestalt School, touches on an idea similar to that of Mackworth's:

To envisage, to put the right problem, is often a far more important achievement than to solve a set task."

Piaget has been critical of orthodox Gestalt theorists who deny a developmental aspect, but the less extreme positions of Gelb and Goldstein for instance, who have rejected the notions of 'physical gestalten', are more acceptable to him. Wertheimer, however, in spite of his Gestalt inspirations, does not hold a passive concept of the individual, stemming from an emphasis on structural determinism, rather, he sees the individual as playing some more active role in the construction and reconstruction of problems. It is important to stress here that the Gestalt School has an important contribution to make to the discussion of the creative process, in terms of re-structuring, though the motivational or dynamic aspects of their explanation are not always accessible to a developmental explanation.

One of the problems of reviewing literature in the field of creativity is that because of the vagueness of the concept there are many territories into which one might wander, but they bear other labels. There is the further problem of selection, in view of the varied array of definitions and approaches. At this point, therefore, it might be helpful to consider more closely some of those theorists who have attempted to analyse the process of creativity, returning, at a later point, to consider the implications of definitions and explanations for assessment and for a qualitative understanding of the concept of creativity.

Earlier this century, George Wallas (1926) provided an analysis of the birth of thought, which well illustrates the problems of attempting to trap such complex processes in test measures, especially when the thought processes are concerned with divergent issues. Wallas made an important point concerning the consciousness of such processes:

"... unless we can recognise a psychological event, and distinguish it from other events, we cannot bring conscious effort to bear directly upon it..."

Commenting on Helmholtz's analysis of thought processes, Wallas continues to explain the problems of unravelling thought processes, which are rarely clear cut and usually intermingled with other thought processes:

"... our mental life is a stream of intermingled psychological events, all of which affect each other, any of which at a given moment, may be beginning or continuing or ending, and which, therefore, are extremely hard to distinguish from each other."
(Ibid)

One might conclude from such observations that a difficulty in attempting to assess the creative process, is that one is forced to present a problem to a subject, and request that the subject focus upon that problem in a way which isolates it from a rich medley of background processes and problems.

Wallas has given some consideration to the processes leading to the emergence of thoughts, and in particular to the emergence of 'creative thoughts'. He takes Helmholtz's three stages, names them and adds a fourth stage of his own. The first stage is termed Preparation during which the problem in hand is considered and investigated by the individual from as many angles as possible. This stage of thought is followed by a period called Incubation. There are two aspects with regard to incubation: the one concerned with the unconscious and involuntary mental events which may take place during incubation (and which might lead to the third stage of Illumination), and the fact that during this stage we do not voluntarily

or consciously think on a particular problem. Incubation is clearly a period which requires time, and further, the length of time cannot be specified in advance - a further problem for standardised assessment. Similarly, the 'best' conditions for this period would be difficult to define and to apply in a controlled way, and yet this is the critical period for the genesis of ideas. For assessment purposes, it is perhaps the stage we would most like to understand and control, and most need to control. In practice, so far, much research has proceeded as if the process could be explained and controlled and timed. During the third period of Illumination, a solution may be recognised and realised, and during the fourth period of Verification, the processes are characterised by conscious and logical activities. Wallas talks in association terms - of trains of thought - he raises problems such as insight (Gestalt) and terms such as 'fringe' (William James) in his attempts to describe the processes preceding illumination.

Carl Rogers (1959) has discussed creativity in terms of a process within the context of his personality theory. He makes reference to the processes which Wallas has called Incubation and Illumination:

"From the very nature of the inner conditions of creativity it is clear that they cannot be forced, but must be permitted to emerge. The farmer cannot make the germ develop and sprout from the seed; he can supply only the nurturing conditions which will permit the seed to develop its own potentialities."

Once again, in this comment, the problems of trapping creativity in assessment situations are stressed. Rogers describes the creative process in the following terms:

"My definition then, of the creative process, is that it is the emergence in action of a novel relational product, growing out of the uniqueness of the individual on the one hand, and the materials, events, people or circumstances of his life on the other." (Ibid)

More importantly, in terms of the standpoint of this study, Rogers insists that such a process is not restricted to some particular content. Neither does he make distinctions between what he terms 'good' and 'bad' creativity which would involve one in social evaluation and which is, as Rogers notes, subject to fluctuations.

The motivational aspect of creativity is explained, by Rogers in terms of "man's tendency to actualise himself, to become his potentialities". Whilst he feels that it is of little help to examine the intentions and purposes of the individual participating in the creative process, because something deemed creative might well emerge from apparently unrelated intentions, Rogers does believe that certain conditions facilitate creative behaviour. To become truly involved in the creative process the individual requires "openness to experience", an "internal locus of evaluation" and "the ability to toy with elements and concepts". Rogers also cites important external conditions which will lead to psychological freedom and safety and allow the individual freedom to actualise his potential. Much research into creativity has attempted to satisfy some or all of Roger's conditions. Unlike Rogers, there are those (e.g. Osborn, 1953) who believe that creativity can be deliberately facilitated, but most have attempted to structure "free", "playful" and "non-threatening" situations. How effectively one can structure for these in the microcosm of the assessment situation is, at best, questionable.

Ghiselin (1955) in his editorial to The Creative Process explains that it is only as the creative work is done that the meaning of the creative effort can be appreciated. Production by a process of purely conscious calculation seems never to occur. One may attempt, according

Rogers, C. (1959) Ibid.

Osborn, A. (1953) Applied Imagination: Principles and Procedures of Creative Thinking.

Ghiselin, B. (1955) (ed.) The Creative Process.

to Ghiselin, to calculate the conditions, even the materials upon which a subject is to work but there is no certainty that the outcome of these conditions, materials and processes will be one of creative structuring.

Ghiselin (1955) writes:

"...the creative order ... which is an extension of life, is not an elaboration of the established, but a movement beyond the established, or at the least a reorganisation of it and often of elements not included in it... New life comes always from outside our world as we commonly conceive that world."

It would seem once again that whilst one might well analyse the parts of a creative process, it would be extremely difficult to set up situations in which to assess these, especially as there is no guarantee that creativity will come about.

The process notion is an important one in the considerations of Freud (1938). Essential to the creative process is productive conflict. The creative person is one who is able to accept freely rising ideas. When creative processes are in action, the ego, which is governed by the reality principle, and which controls the access of ideas to consciousness, suspends its censoring functions. This release is obviously only temporary - a sustained state would patently be pathological. Freud is speaking in personality terms, but, within a cognitive explanation, freedom stems from the realisation that culturally accepted logic is simply one way of structuring and interpreting, and further, that at points it might be profitable to examine the potential of other logics.

Freud (1959) likened creative behaviour to aspects of child's play, stressing as he did so the awareness of reality that creative behaviour always maintains:

"The creative writer does the same as the child at play. He creates a world of phantasy which he takes very seriously - that is, which he invests with large amounts of emotion - while separating sharply from reality."

Ghiselin, B. (1955) Ibid. P.14.

Freud, S. (1938) The Basic Writings of Sigmund Freud. A.A. Brill (trans/ed)

Freud, S. (1959) "Creative writers and daydreaming" in: Stratcher, J. (ed) Standard Edition of the Complete Works of Sigmund Freud. Vol 9, P.143.

The stages of Wallas, and the conditions of Rogers speak of the need of a link with reality at points within the creative process. McKellar (1957) speaks of the need for a right relationship between autistic thinking and reality-adjusted thinking, in creative behaviour. Clark, Veldman and Thorpe (1965) require that individuals should have mature and adequately controlled ideational processes. They investigated the relationship between divergent thinking and certain perceptual tasks using the Holtzman Inkblot Test. The material led to free phantasy responses in the subjects, and such responses were 'often found to be unconventional', but, according to Clark et al, such responses were not pathological and were ideationally controlled. Shouksmith (1970) asks that the individual should have the ability to highlight the essentials of the associations he makes, should be able to evaluate the relationship, and further, that he should follow it through or develop it from the initially conceived idea. In short all of these theorists are concerned to state that the creative process, at certain points, must be characterised by conscious, deliberate activity. Creative processes are not to be confused with phantasy.

George Kelly (1955) is concerned with constructs of reality and the ways in which an individual construes reality. There is a place for creativity within his personal construct theory. Kelly talks of the construing process by means of two separate but inter-related cycles: the CPC Cycle (Circumspection, Preemption and Control) and the Creativity Cycle.

McKellar, P. (1957) Imagination and Thinking.

Clark, C. Veldman, D. and Thorpe, J. (1965) "Convergent and divergent thinking abilities of talented adolescents", J. of Ed. Psy. 56 pp 175-63.

Shouksmith, (1970) Intelligence, Creativity and Cognitive Style.

Kelly, G. (1955) The Psychology of Personal Constructs. Vols 1 and 2.

"The CPC Cycle starts with circumspection, which enables the person to look at his elements propositionally, or in a multi-dimensional manner... he selects what he believes to be the crucial issue... Thus, by preemption he sets up a choice point, a cross-roads of decision... but the CPC Cycle does not end with preemption. There is still the choice to be made... as we have indicated before in our Choice Corollary, a person chooses for himself that alternative in a dichotomised construct through which he anticipates the greater possibility for extension and definition of his system."

Though couched in somewhat different terms, Kelly offers an interpretation of knowledge-construction which is in harmony with this study, though he does throughout his theory confine himself to an adult model. Apart from the ability to view reality from other dimensions, he requires that the individual be capable of conscious selection and choice. Having described his CPC Cycle which starts with propositional constructs, and which is concerned with viewing constructs from different angles rather than with the birth of new constructs, Kelly describes his second cycle - the Creativity Cycle:

"... which starts with loosened construction and terminates with tightened and validated construction."

and:

"... loosened construction is that which is characterised by varying alignment of elements, while tightened construction involves rigid assignment of elements within the construct's context."

The Creativity Cycle starts in the loosened construction as the individual shows what Kelly terms a shifting approach to his problems:

"... what makes the ambiguity meaningful in the Creativity Cycle is the person's ability to experiment minimally with each transient variation, then to seize upon one of the more likely ones, tighten it up, and subject it to a major test."

Kelly goes on to explain that a person who is in the habit of employing tight constructs cannot be creative - though he might be very productive.

He will, however, always turn out alternatives which have been blue-printed. Similarly though:

"... just as a person who uses tight constructions cannot be creative, so a person who uses loose constructions exclusively cannot be creative."

Whatever the terminology or frame of reference, after the loosened construction, after the processes following the relaxation of the ego, after re-construction of reality, there has to be a process of recognition and of definition of the reality identified. Further, there seems to be much general agreement so far that what is recognised and defined as 'creative' by the individual might not receive the same valuation by society. Kelly echoes this point, reiterating the distinction between process and product:

"When he is finished his idea is expressed in a form which is somewhat more communicable, though it may still defy verbal description and it may still look like a shapeless mass to unsympathetic spectators.

Kelly makes the points that constructs are usually preverbal at first, and;

"As his new construct begins to take shape, the creative thinker is likely to be hard pressed to find a suitable symbol for it."

There is some relationship here with Piaget's idea that understanding of phenomena is related to ability to define (not necessarily verbally) that phenomena.

Whilst a number of theorists can be included in a discussion of processes of creativity, it is important to point out that different strategies are often included under 'process' according to definitions and understandings of what creativity is about. There are those who regard the process in 'associational' terms (Wallach and Kogan, 1965), whilst others approach creative behaviour in terms of elaboration of ideas, (Torrance, 1973).

Kelly, G. (1955) Ibid. P.529, P. 999 and P.1051.

Wallach, H. and Kogan, M. (1965) Modes of Thinking in Young Children.

Torrance, E.P. (1973) Torrance Tests of Creative Thinking. (Tests & Manual)

Shouksmith (1970) commenting on Wallach and Kogan (1965) explains the process in terms of:

"the ability to produce associates, and especially unique associates freely."

Bartlett (1958) speaks of closed-system and of adventurous thinking. In this latter category he includes both creative and scientific thought, though there are distinguishing features. Of adventurous thinking, he writes:

"The conditions for original thinking are when two or more streams of research begin to offer evidence that they may converge and so in some manner be combined. It is the combination which can generate new directions of research."

Mednick (1964) concerned with creativity as process, explains it almost wholly in associational terms;

"Creative thinking consists of forming new combinations of associative elements, which combinations either meet specific requirements, or are in some way useful. The more mutually remote the elements of the new combinations, the more creative is the process or solution."

This stress on the need for mutually remote elements is enshrined in Mednick's Remote Associates Test. However, as will be discussed later, it is questionable that remoteness is essential to creative outcomes. It is on this point that Mednick seems to confuse process with product.

Edward de Bono (1970) in his work on lateral thinking is concerned with the idea of escaping from restricting thought patterns to new ones. He is very process-conscious in his approach to the subject and, as will be seen later, in his attempts to foster thinking in its different forms. Lateral thinking according to de Bono is:

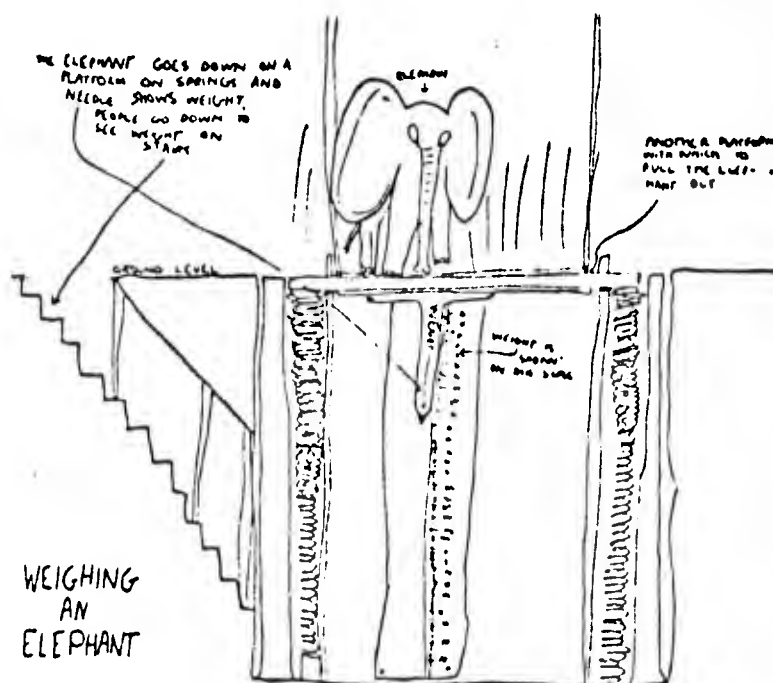
"... closely related to creativity. But whereas creativity is too often only the description of a result, lateral thinking is the description of a process."

Shouksmith, G. (1970) Intelligence, Creativity and Cognitive Style. P.125.

Bartlett, F.C. (1958) Thinking: An Experimental Study.

Mednick, S.A. and Mednick, M.T. "An associative interpretation of the creative process", Psy. Rev. Vol 69, No 3, pp 220-232.

de Bono, E. (1970) Lateral Thinking. P.11.

PLATE 3.

"If you were a zoo keeper and wanted to know how heavy an elephant was how would you do it?"

"The purpose of this problem was to see how children dealt with this matter of size and weight. . . would they take the great weight into account? . . . Would children grasp the principles involved (of weight and balance) or just borrow complete machines for the purpose?"

De Bono classifies the above response of a 10 year old boy as a "lateral thinking solution". As a problem, in terms of structure and direction, it falls somewhere between a Wertheimer type task where "the problem itself arises from the structure of the given material"('61), and an open type creativity task inviting imaginative responses.

Taken from: Children Solve Problems. de Bono. E. '72.

Essentially, the formation of new categories and new associations involves the individual concerned in what might be termed 'code-breaking' for 'new' associations as such cannot be patterned and passed on by a culture, as is the case with common, generally held associations:

"Now the content of categories are built up through experience, so that to members of the same culture, systems tend to be highly similar. This in turn means that a given event will tend to be coded in a similar way by most members of a given culture - coding becomes highly stereotyped in fact. Nonetheless, some people, despite their common cultural background, retain the capacity to make novel and unusual codings, which manifest themselves as creative thinking." Cropley, 1967.

Such new codings or free associations of ideas are well exemplified in the efforts of say a Virginia Woolf or an Eliot, where disparities are collapsed to create new relationships and where communication is based on poetic symbolism. And in the case of Virginia Woolf (1953 and 1932) there is much evidence of a conscious struggle to achieve a new logic, a new construction of reality. Eliot (1944) who has struggled to create new patterns and relationships, has a comment to make on the problem of 'set':

"There is it seems to us
At best, only a limited value
In the knowledge derived from experience,
For knowledge imposes a pattern, and falsifies,
For the pattern is new in every moment
And every moment is a new and shocking valuation."

This is the heart of the tension which must characterise any creative process. On the one hand there is need for experience, for an accepted way of knowing and of interpreting reality, for only on the basis of such can one depart to other realities. At the same time, there is a need for a level of consciousness and understanding which will enable the individual to realise that categories are man-made - and that man can be free to create other categories.

Cropley, A.J. (1967) Creativity. P.38

Woolf, V. (1953) A Writer's Diary.

Woolf, V. (1932) The Common Reader.

Eliot, T.S. (1944) East Coker: The Four Quartets.

Research into creativity has many points of departure with various findings. Because of the diversity of the assumptions and resulting methodologies, comparison clearly becomes a problem. One common factor, however, in much of the research discussed so far, is that most of it assumes, implicitly or explicitly, an adult model. Perhaps this assumption is a way of saying that a certain level of cognitive ability is necessary for creative behaviour. However, such a model does not attempt to explain the development of creative behaviour or the stages, if any, of such development.

In a developmental approach there is an admission of differences on an age or stage basis. This admission leads to some attempt, in any measures of creativity employed, to discriminate against childish, ego-centric responses, distinguishing them from objective, adult responses. Different qualities or levels of response would be anticipated at different stages or ages.

Much of the early work in the area of creativity was descriptive and lacked the controls which are now seen to be essential. There is inadequate explanation of terms such as "imagination", "phantasy" and "creative", and at times they are used almost interchangeably. Ribot (1906) talks of the idea of rivalry between the growth of reason and the growth of imagination. McMillan (1924) identified three stages of imagination. She described the first stage as one in which the child possessed a "sense of beauty". In the second stage, he comes to terms with reality, asking about cause and effect for instance, and in the final third stage, he begins to work out some order in the world as he perceives it. In spite of the essentially descriptive approaches of both, there are aspects of these findings which have been developed and empirically investigated by more recent researchers.

Ribot, T. (1906) Essay on the Creative Imagination.

McMillan, M. (1924) Education through Imagination.

For instance, Torrance (1965) takes up, in his own terminology, this idea of rivalry between imagination and reason, and whilst McMillan used 'stage' in no technical sense (Tanner and Inhelder, 1956) the idea of growth into some more organised way of perceiving reality has been developed and much investigated.

In 1930 Andrews set about a study of the area in a more systematic manner. He concluded that total imaginative scores are highest between four and four and a half years of age and that there is a sudden drop around five years of age. However, one is left questioning a number of Andrews' distinctions - especially his apparent confusion between phantasy and imagination which might explain the sudden drop in scores around five years of age or so.

Ruth Griffiths (1945) identified two stages in the creative drawings of children and she related them to a study of imagination in early childhood. As well as a consideration of these drawings, she also employed a method of observation of free-play in a structured situation. However, systematic though she is in many ways, she too makes no real distinction between terms such as imagination and phantasy. At one point, she refers to phantasy as "the manner of thinking natural in childhood" (chapter XVII) and at another to the fact that: "imagination has long been recognised as the characteristic mode of thinking during the period of early childhood" (chapter XX). What she does delineate, however in the eleven stages she draws up on the basis of her examination of children's drawings, is a passage which indicates growing organisation and complexity of thought.

Torrance, E.P. (1965) Rewarding Creative Behaviour.

Tanner, J. and Inhelder, B. (1956) Discussion in Child Development, Vol IV.

Andrews, E. (1930) The Development of Imagination in the Preschool Child.

Griffiths, R. (1945) A Study of Imagination in Early Childhood.

Mearns (1931) discussing creative activity, maintains that this activity enjoys free expression during the first three grades (of American schooling), and to some extent, remains in the fourth and fifth grades. According to him there is a rapid decline of free expression in the sixth and seventh grades and by the eighth grade the ability would seem to be lost, though Mearns argues that the ability to be creative can be revived at any age, even adulthood. What is required here is some systematic investigation as to the nature of such activity at different grade levels, and suggestions for the reason for decline, and possible re-appearance, of creative ability. For in spite of a certain vagueness, the idea of changes in response-rates is an interesting one, and might be explicable in terms of phantasy versus imagination (Piaget, 1951), rather than in terms of a rise or fall in the same ability. The drop in 'creative output' in Mearns' investigation could be interpreted as the child coming to terms with the demands of rules and contexts, in other words, a lessening of ego-centric responses. The revival of 'creative output' would be explained as recognition of other modes of signifying and relating phenomena.

Torrance (1964) considered the developmental curve of imaginative abilities. He found during the course of this research that there was a steady increase in imaginative ability from first through third grade. A sharp decrease was noted too, between the third and fourth grades, followed by some recovery during the fifth and sixth. That there is a strong similarity between the findings and interpretations of Torrance and Andrews (1930) is not surprising as Torrance based this part of his work on Andrews'. Concerned to find reasons to explain this developmental curve, Torrance studied the process in other cultures, drawing

Mearns, H. (1931) The Creative Adult.

Piaget, J. (1951) Play, Dreams and Imitation in Childhood.

Torrance, E.P. (1964) "The Minnesota Studies of Creative Thinking" in: Widening Horizons in Creativity, Calvin W. Taylor (ed).

samples of both rural and urban subjects from Western Samoa, India, Australia, Norway and Germany. Torrance (1964) found different developmental phenomena taking place in these cultures:

"In brief, we find that in cultures or subcultures where there are few discontinuities, there is no drop in these developmental curves. In cultures which have the cultural discontinuities, as our culture has, at about ages 5, 9 and 13 we find these drops."

It is Vernon (1948) who makes a distinction that this study would prefer to rest upon. He maintains that constructive imagination does not occur in the child of normal intelligence and emotional development until at least the age of eleven. Vernon based his conclusions on the ability of subjects to understand a series of pictures and to show ability to interpret these pictures as a whole, rather than focussing on details, indicating a lack of syncretic perception. Vernon found that at the age of eleven years, children could invent explanations of the scenes depicted, in terms of thoughts, emotions and activities of the characters portrayed. Such findings fit in well with Piaget's, in terms of the onset of formal operational abilities at about the same age.

Liam Hudson (1966 and 1972) much influenced by the work of Getzels and Jackson, and researching into convergence - divergence (the latter not to be treated as synonymous with creativity), draws conclusions which have some relevance for developmental studies of creativity and related areas:

"The identity of convergent and divergent children can be seen, in other words, as crystallising to different extents and at different stages: the convergent during the latency period, the divergent in adolescence. The internal economy of the convergent child, the future scientist, might be said to gel at the stage in his development when issues of rationality and internal control are paramount. That of the divergent child, the future arts specialist, sets less firmly, and at a stage when emotional considerations are again more pressing." (1972)

Torrance, E.P. (1964) Ibid. P.136.

Vernon, M. (1948) "The development of imaginative construction in the child," Br. J. Psy. 39, 102-111.

Hudson, L. (1966) Contrary Imaginations.

Hudson, L. (1972) The Cult of the Fact. P.68.

Whilst Hudson's investigations are generally concerned with personality dimensions of the problem, his developmental outline is in accord with the notion that logical thinking will precede and be the foundation for what is here termed creative thinking, and that creative thinking could reach its developmental peak in adolescence.

E.S. Schachtel (1959) puts forward an explanation of creativity in perceptual terms. Whilst his theory is a theory of personality, he employs concepts which perhaps bear some relation to those of Piaget, though within a different frame of reference. Further, his theory is a developmental one. Schachtel proposes two perceptual modes - the first being autocentric, and the second the allocentric. By autocentric, he means that in the process of perception there is little objectification, the process being affected by the subjective state of the person. There is perhaps here, some parallel with Piaget's concept of 'assimilation'. Similarly, the allocentric mode of perception might be compared with Piaget's concept of 'accommodation', for in both instances there is a process of objectification, although the reasons for lack of objectification are quite different in the two theories, Schachtel's being essentially an explanation of personality. Whilst underpinned by different rationales, both can be seen as equilibrium-theories of behaviour, and in both there is a movement towards objectification with age. During the process of development, there grows out of the autocentric mode of perception what Schachtel terms secondary autocentricity, by which he means that:

"objects are most frequently perceived from the perspective of how they will serve a need of the perceiver, or how they can be used by him..." Ibid.

Schachtel, E.S. (1959) cited in Getzels and Jackson (1962) Creativity and Intelligence. Pp 112-117.

Further, this mode is characterised by a fear of events or of objects and situations which might disturb or threaten by their newness or strangeness (what Schachtel terms: "embeddedness"). Creativity within this developmental framework is defined as:

"...the art of seeing the familiar fully in its inexhaustible being, without using it autocentrically for purposes of remaining embedded in it and reassured by it." Ibid.

It is when this allocentric mode of perception has some real measure of control that creativity is possible, because this mode of perceiving obliges one to go about perceiving reality in ways and from angles other than those normally selected for reasons of 'safety'. Creativity stems then, in this theory, from a kind of tension. Cropley and Rogers refer to the role of tension in the creative process when they speak of creative individuals as being capable of supporting a high degree of cognitive dissonance or conflict; however, they speak within different theoretical frameworks.

There are numerous other pieces of research which, whilst not directly concerned with creativity as such, might well have implications for this area, especially in terms of measures of creative behaviour, or more precisely, the construction of such measures.

Rhoda Kellog (1969) for instance, analysing children's drawings, has suggested some interesting developmental trends. The subjects in her studies represented a wide age-range, starting as young as two years old and drawn from a wide socio-economic range. Essentially, this was an observational task spread over 20 years. Kellog was primarily interested in line formations in children's scribble and drawings, maintaining on

Schachtel, E.S. (1959) Ibid. P.113

Kellog, R. (1969) Analysing Children's Art.

the basis of her observations that "there are lines and designs that occur regularly and quite clearly in the drawings of many children" (ibid). Herbert Read, in his Presidential address to the Society for Education through Art, supported this notion:

"... we have a hypothesis that should hold the field until it has been proved to be false. According to this hypothesis every child in its discovery of a mode of symbolisation, follows the same graphic evolution."

A point here that might of interest in this study, is simply that until we are aware of such developmental determinants, and their effects, if any, upon expression, the assessment of graphic creativity might well be inadequate. A number of researchers (Franck, Torrance, Barron and others) attempt to assess creativity by means of drawings of some type. Kate Franck's Drawing Completion Test is one such instance (PLATE 4). Franck required subjects to elaborate on basic stimulus lines, and these elaborations were then evaluated, according to stated criteria, as "creative" or otherwise. If, however, elaborations are determined by this 'graphic evolution' of which Herbert spoke (1963) then such an evolution should be taken into account in any evaluation of children's graphic output.

Many more recent studies, especially those concerned specifically with creative behaviour have been non-developmental in their approach.

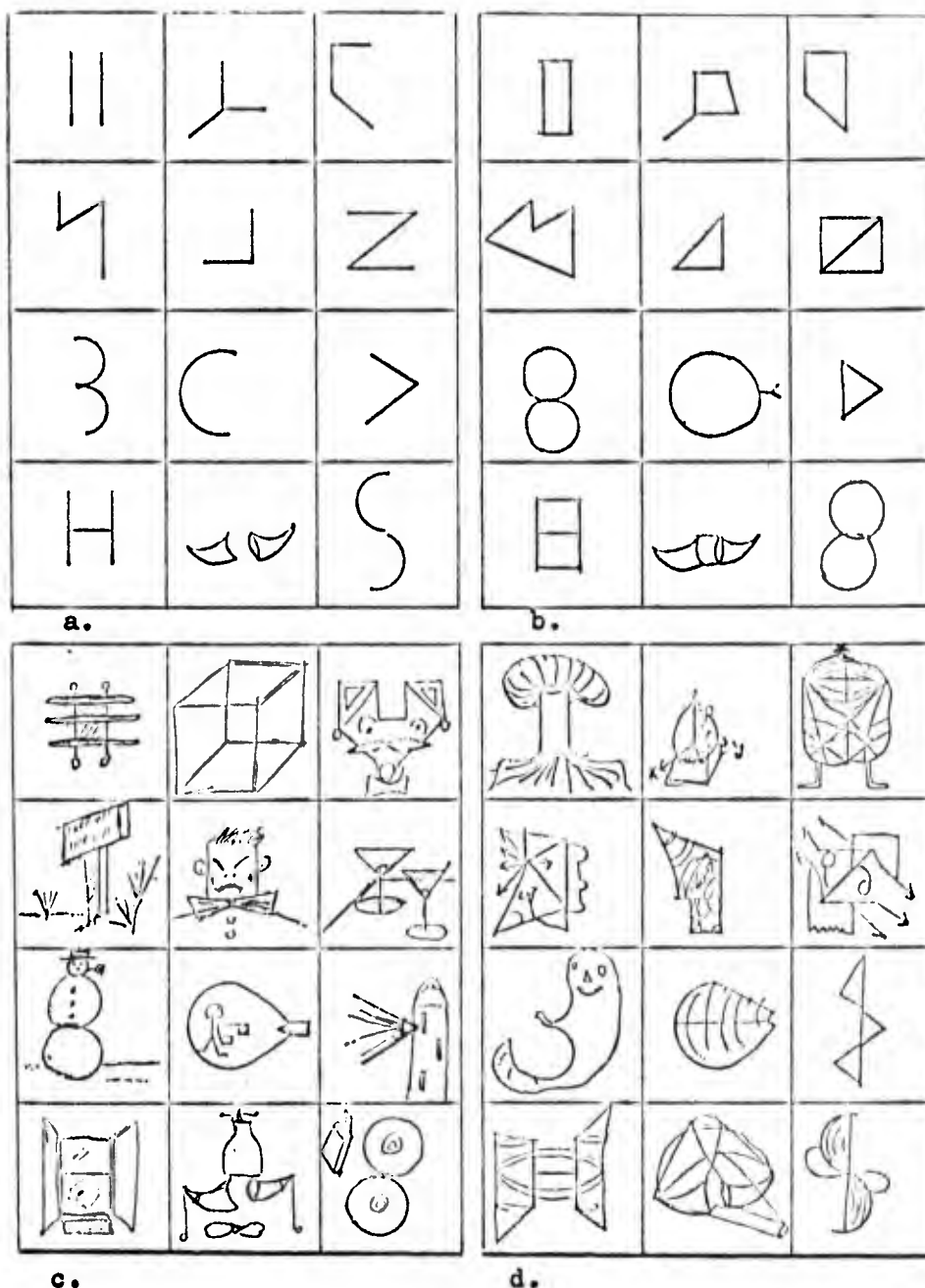
Wallach and Kogan (1966) had two major aims:

"... we wished to determine whether solid evidence could be found that would support the validity of a distinction between intelligence and creativity as modes of cognitive activity. Second, if a distinction between these concepts could be given acceptable empirical support, we wished to investigate the possible psychological correlates of individual differences in creativity and intelligence when variations along these two dimensions were considered jointly."

Read, H. (1963) Address to 4th Gen.Ass of Int. Soc. for Educ. thro' Art. Montreal.

Franck, K. (1952) The Drawing Completion Test.

Wallach, M. and Kogan, N. (1966) Modes of Thinking in Young Children. P. 1

PLATE 4.The Drawing Completion Test (Kate Franck. 1951-52)

- a. the simple figures on which subjects were required to elaborate.
- b. instances of non-creative responses (according to Franck et al.)
- c. and d. instances of creative responses. (according to Franck et al)

Torrance and Barron et al used modified versions of this test in their assessments of creative behaviour.

As they explain themselves, Wallach and Kogan were asking if something like Spearman's 'G' could exist within this area termed "creativity". Wallach and Kogan defined creativity in associational terms - the production of associative content which would be unique; and further, they wished to include in their definition a playful, permissive task-attitude on the part of the person making the associations. They drew up five measures of creative behaviour defined as follows: Instances, which required that the subject generate possible instances of class concept specified in verbal terms; Pattern Meanings where the child was asked to provide possible meanings or interpretations for a number of abstract visual designs; Alternate Uses, where this time the subject was asked to generate possible uses for a verbally specified object; Similarities, which required the child to supply possible similarities between two objects, and the final measure Line Meanings, a further visual measure, adapted from Tagiuri 1960, required the child to interpret or provide possible meanings for the stimulus lines. In all instances, free associations could be involved. Wallach and Kogan were concerned in the case of each measure to assess two related variables, namely the number of unique responses produced by the child and the total number of responses produced by the child. Within their research, "intelligence" was defined as measured by standardised tests, namely 3 sub-tests from the WISC, SCAT and STEP.

It is important, in any attempt to relate creativity to intelligence to be clear as to what is intended by both concepts. As already indicated earlier in this chapter, concepts of creativity vary and this could have some implication for correlation of item results at later stages of investigation. There is, it would seem, a need for some closer examination of starting concepts. To say that intelligence and creativity do, or do not, relate is not to describe or necessarily understand the nature of the items, and the nature of the relating of these items. One might ask, for instance,

why results based on criteria such as statistical uniqueness (Wallach and Kogan, 1966), or results based on fluency (Ibid), should necessarily correlate with IQ measures dealing with, for instance, logical development or ability. Whilst one is not denying IQ-Creativity relationships when and where they exist, there is a definite need for a psychological as well as a statistical definition of the relationships. To know statistically that X and Y relate, is to know that they relate. It is not necessarily to imply that X and Y are the 'same', though they could be. X might, in fact, be dependent upon Y. This could be isolated statistically, but more is required. To speak of a relationship is to speak of many potentially different things. To speak of a creativity-intelligence relationship is to imply, in the first place, a distinction between the two factors, to see creativity as a separate cognitive function. Significant statistical relationships may be doing little more than uniting factors which should never have been conceived of as distinct, in the initial definitions and theory.

Hudson (1970) raises this question for slightly different reasons:

"I cannot for the life of me see why research in this field (i.e. creativity-intelligence) has placed so little confidence in demonstrable differences between convergers and divergers. If convergers and divergers differ, and in ways unconnected to the tests used in their definition (my underlining), this is evidence that low intercorrelations among measures of divergence have been misconstrued."

Hudson goes on to suggest the need for a more detailed examination of this area as a topic of interest in its own right, suggesting that differences may exist but have yet to be clearly defined. It would seem certainly from this statement and from findings such as those of Wallach and Kogan (1966) that the notion of a coherent trait termed 'creativity', distinct from intelligence needs further examination, especially at the theoretical stage, before it can be upheld or dismissed.

Working with 150 children (American fifth grade) Wallach and Kogan concluded that their measures of creativity possessed a high degree of internal consistency (the average correlation among the ten creativity measures was on the order of 0.4), and further they concluded that:

"...a dimension of individual differences has been defined here which, on the one hand, possesses generality and pervasiveness, but which, on the other hand, nevertheless is quite independent of the original notion of intelligence." (Ibid)

The correlation between the creativity measures and the intelligence measures was low.

A.J. Cropley (1968) lends only modified support to this finding, having re-examined their data, and Cropley and Maslany (1969) whilst giving some support to the Wallach and Kogan findings, do so with qualifications on the basis of a replication study. Cropley (1968) pointed out that:

"... the Wallach and Kogan battery did indeed retain the property of internal consistency when administered to university students, while cross correlations with the intelligence tests were usefully low... However, it is by no means clear that they elicited a new and separate intellectual mode. Although a substantial degree of separation of the two batteries was effected by factor analysis, a large general factor on which all tests loaded substantially was still obtained."

In spite, therefore, of an initial research hope, it would seem that there was no clear evidence that the two abilities, intelligence and creativity, as they defined them, could be regarded as separate.

Getzels and Jackson (1962) earlier worked with a somewhat select sample of subjects - the average IQ being over 130, and the representativeness of their sample therefore dubious. They assumed that creative thinking abilities would be found to some extent in all persons and were concerned with:

Cropley, A.J. (1968) "A note on the Wallach and Kogan tests of creativity", Br.J. Ed.Psy. 38, 197-201.

Cropley, A.J. and Maslany (1969) "Reliability and factorial validity of Wallach-Kogan creativity tests", Br.J.Psy. 60, 395-98.

Getzels, J. and Jackson, P. (1962) Creativity and Intelligence: Explorations with Gifted Students.

"... a fairly specific type of cognitive ability reflected in performance on a series of paper and pencil tests."

In all they employed five measures of creativity, involving verbal and numerical symbol systems and tasks dealing with object-space relations. The score depended not upon a single pre-determined response, but on the number, variety and novelty of the responses for each task. Apart from criticism of their sample, there are comments to be made on the diffuseness of their starting concept (Wallach and Kogan, 1966). Though Getzels and Jackson had hoped to provide some evidence on the relationship between intelligence and creativity, the evidence was in fact inconclusive. Torrance and Gowan (1963) examining the intelligence-creativity relationship, make the point that, on the measures employed by Getzels and Jackson:

"There are low correlations between verbal and nonverbal creative abilities and they appear to be largely independent..."

Hasan and Butcher (1966), in their study, which was a partial replication of the Getzels and Jackson study, concluded that creativity and intelligence overlapped to such an extent that it was virtually impossible to make any kind of distinction.

Cropley (1966) concluded that:

"... it would be wrong to argue either that convergent and divergent thinking cannot be distinguished from each other factorially, as some authors have suggested, or that they are completely independent of each other... it is unacceptable to think of creativity as a separate basic intellectual mode..."

Getzels, J. and Jackson, P. (1962) Ibid. P.16.

Wallach, M. and Kogan, N. (1966) Ibid.

Torrance, E.P. and Gowan, (1963) "The reliability of the Minnesota tests of creative thinking", Research Memorandum. Bur. Ed. Res. 4.

Hasan, P. and Butcher, H.J. (1966) "Creativity and intelligence", Br. J. Psy. 57. pp 129-35.

Cropley, A.J. (1966) "Creativity and intelligence", Br. J. of Educ. Psy. 38, pp 259-66.

In his research, using an unselected group of children, Cropley employed seven measures of divergent thinking and six to assess convergent thinking. Like Hasan and Butcher (*ibid*), some of his divergent measures were based on Torrance's and Mednick's work. Cropley factor-analysed a representative selection of both types of tests employed, and found five significant factors, two of which he identified as factors of both convergent and divergent thinking. Orthogonal rotation suggested that it was impossible to find a factor of divergent thinking that did not also have high loadings on some convergent measures. Hence his conclusions about the intelligence-creativity relationship.

Yamamoto (1965) came to similar conclusions working on a sample of primary school children in the USA. Creativity tests, he concluded, were best to be seen as complementary measures, and no clear distinction could be made about the creativity-intelligence issue.

The work in this current study is not concerned with theoretical systems which conceive of intelligence and creativity as separate cognitive modes. Neither is it satisfied that associative-type definitions of creativity are adequate, though they may cover certain kinds of creative functioning. Intelligence, as understood in this research is conceived of in Piagetian adaptive terms; it is a way of knowing, as is creative behaviour, and they are not to be regarded as distinct from one another. As ways of knowing and of interpreting reality, they require the same operational structures to govern the different stages of behaviour. If there is any distinction to be made it is simply in terms of the how of cognitive functioning: knowing can address itself to conventional logical systems, similarly it can be concerned with more divergent ways of apprehending

Yamamoto, K. (1965) "Effects of restriction of range and test unreliability on correlation between measures of intelligence and creative thinking", Br.J.Ed.Psy, 35, pp 300-5.

and interpreting reality. Here lies the distinction. But it is a distinction rooted in the function and not in the structure of the behaviour. Creativity is not a behaviour per se. Any act could become creative depending upon the dispositions of the knower, and his level of cognitive functioning. There are not different types of creativity - e.g. verbal or pictorial - but creativity can be expressed in different forms, and fluency in any one form is related to an individual's experience in that form.

Bearing this in mind, it becomes necessary to ask to what extent, if at all, previous measures of creativity have attempted to discriminate against ego-centric, phantasy responses as opposed to conscious creative responses. In other words, for a yet further clarification of the concept, consideration of scoring methods is necessary. Unless discriminations are made against ego-centric, phantasy responses, one could simply end up correlating "ego-centricity" with "intelligence" - and it is likely that the relationship will be favourably low!

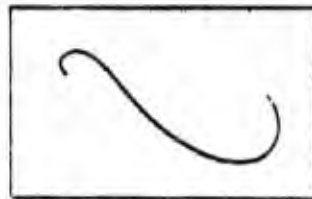
The Wallach and Kogan research (1966), on the assessment of creativity, is concerned with two main measures - the uniqueness and the number of responses (PLATE 5). These measures are applied to all of the creativity tasks. Both measures raise problems. Uniqueness is defined by Wallach and Kogan in statistical terms. It refers to a response which is given by one child only out of their entire sample of 151. Such measures make no attempt to explain a response, especially in terms of its nature. They have little, if anything, to do with the structure of the response, and whilst Wallach and Kogan hope to discriminate against 'bizarre' responses (still somewhat subjective and subject to evaluation) there is no certainty that they, on the basis of such measures, discriminate against ego-centric responses.

PLATE 5.From: Modes of Thinking in Young Children.

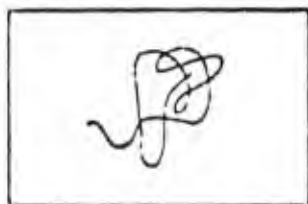
Wallach-Kogan. 1966.



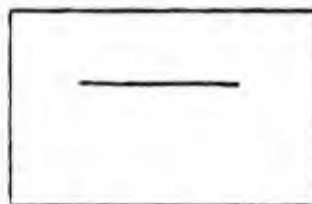
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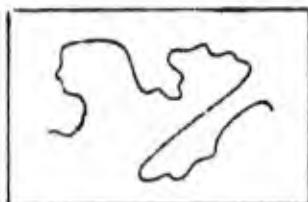
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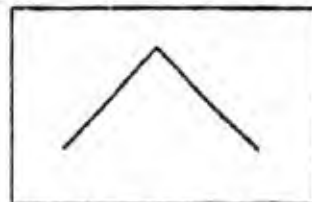
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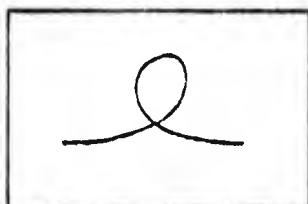
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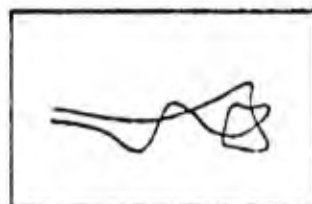
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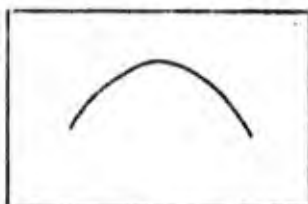
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8



9

Stimulus Materials for the Line Meanings Test. The actual Test Cards measured 4 x 6 ins. The Test was adapted from Tagiuri (1960).

In this test the subject was asked to generate meanings or interpretations relevant to the form of the line in question. Variables of uniqueness of responses and number of responses were scored.

statistical responses. It may well be that such responses could also be rated as creative in qualitative terms, but given the method employed, responses of a flippant nature such as "a split hair" or a "flattened zig-zag" might well satisfy the requirements of the Line Meanings Items, such is the lack of a structural relationship between the items and the responses.

There is much of Torrance's work which has inspired the early preparation for this particular research project. One of Torrance's concerns when developing the Minnesota Tests of Creative Thinking was to find a set of tasks which could be administered from kindergarten right through graduate school (Torrance, 1965 and 1973). His initial attempts involved adapting Guilford's Unusual Uses Test involving bricks. Underpinning his tests are principles which Torrance proposes might be used in attempts to develop creativity. He refers to such as 'props' or 'starters'. They are of interest here because they relate strongly to the concept of identity as employed in this study. The questions concerned all involve adaptation extension or development of "identity". For instance:

What would happen if we add something?
 take something away?
 multiply it?
 divide it?
 make it bigger?
 take something away and put something in its
 place? etc.

These and other questions suggested by Torrance for encouraging creative responses can all be interpreted as questions of 'identity', and responses could be examined in qualitative terms. His Product Improvement Test, using stuffed toy animals, is a test reflecting what can be interpreted as the 'identity dimension':

Torrance, E.P. (1965) Rewarding Creative Behaviour.

Torrance, E.P. (1973) Torrance Tests of Creative Thinking (Tests & Manual).

"We believe that the ability to elaborate an idea is a valuable kind of creative ability. The successful creative person must sustain his original insight, elaborate upon it and develop it to the full." (1965)

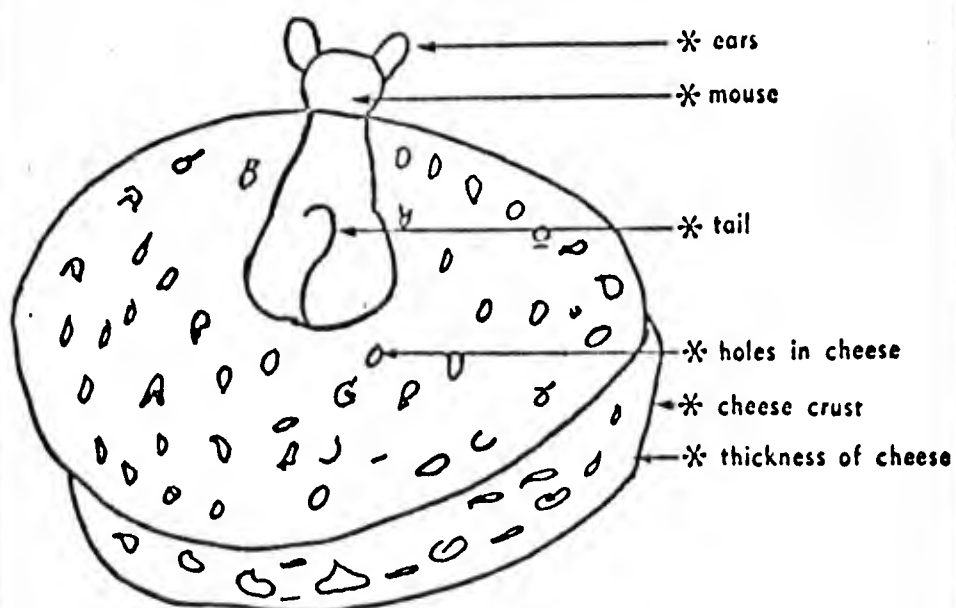
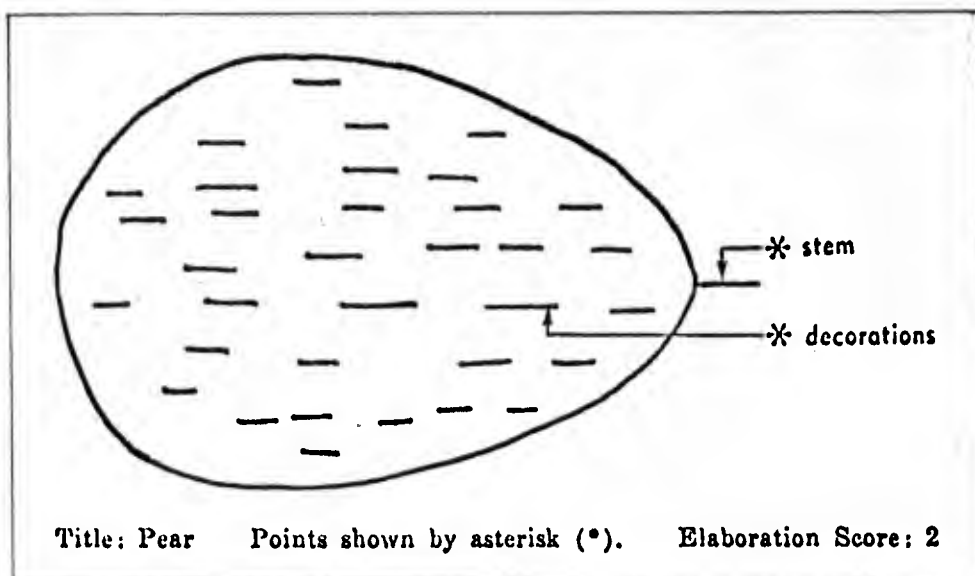
Other items of Torrance might well be said to have influenced measures developed for this project, but as with Wallach and Kogan there is very real disagreement with regard to his scoring techniques. Torrance scored for fluency, flexibility and originality. Fluency was measured by the number of appropriate or relevant responses, flexibility by the number of different categories into which items could be classified (he adapted this from Osborne's categories, 1957) and originality assessed on the basis of statistical infrequency. Once again, then the concern is quantitative rather than qualitative, and perhaps mention should be made of the fact that Torrance sets time-limits to his tests. Throughout his tests, in both figural and verbal type questions this matter of a statistical definition repeats itself. In his examples of scoring (1973) (see PLATE 6), it can be seen that the elaboration score is simply a summation of points for additions to a structure. An interesting question might be - is it the number of elaborations which transform a structure - or is this done by the nature of the elaborations as they relate to the initial structure? Presumably, were one to take item 1 (PLATE 6) and cover the pear-shaped object with varied lines, dots, etc, one could score quite highly - and be more creative?

It would be inaccurate to assume that Torrance is wholly product-minded. He is not, but is interested rather in the processes involved in creative behaviour:

"a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses or formulating hypotheses about the deficiencies: testing and re-testing these hypotheses and possibly modifying and retesting them; and finally communicating the results." (1973)

Torrance, E.P. (1965) Rewarding Creative Behaviour. P.40

Torrance, E.P. (1973) Torrance Tests of Creative Thinking. (Manual P.8.)

PLATE 6

Two examples of the Torrance method of scoring.
From the Torrance Test Manual. 1973.

His statement of intentions and his ideas for the encouragement of creative behaviour would seem to be somewhat in conflict with his mode of assessing creative responses. This encapsulates the dilemma of having to choose between qualitative or quantitative ways of analysing and assessing. What is required is an approach which can treat of qualitative dimensions in quantitative terms - a point to be developed later.

Other areas become problematic when responses are recorded only in quantitative terms. Torrance (1965) reported that he employed, in his earlier work, measures of creativity requiring subjects to make guesses about events in pictures. (A not unsimilar task-"questions"- exists in his recent tests, 1974). The pictures which were all Mother Goose prints, depicted children's behaviour problems. For instance, one such picture showed a boy holding a cat over a well. A girl of about the same age was looking on and another boy had his back turned to the scene. The subjects were encouraged to ask questions and then to make guesses about the events in the pictures. Work in other areas suggests that this type of measure might be inappropriate, especially with younger children, because of important variables not taken into account. For instance, Dorothy Flapan (1968), in a project directed by Jersild, attempted to examine the child's ability to comprehend, through motion pictures, sequences of behaviour. She worked largely within a Piagetian framework accepting Piaget's major assumptions about development. Flapan found that subjects in the younger age group (6+ years), had difficulty in going beyond the immediate information. They were factual in their responses. They tended to focus on detail and were poor in terms of causal relationships and explanations. Burns and Cavey (1957) in an earlier piece of research came up with similar supportive findings with regard to the younger child's difficulties in interpreting events in drawings.

Torrance, E.P. (1965) Rewarding Creative Behaviour.

Flapan, D. (1968) Children's Understanding of Social Interaction.

Burns, N. and Cavey, L. (1957) "Age differences in empathetic ability amongst children", J. Canad. Psy. XI. 227-230

In any assessment of creativity, then, one has somehow to plan for responses which, to the adult, might be of interest, but which in fact stem from the confusion and distortions of the ego-centric thinker. On the same count, many tests as they stand would hardly distinguish against marginally psychotic thinking. McKellar (1957) points out:

"The thinking of a psychotic may exhibit curious discontinuities. These peculiar connections, or absences of connection have been linked to the Knight's move in chess... because of an apparent gap between where the thought begins and where it ends."

Given these problems in assessment, the call might be for a method which is essentially clinical in type and which makes some attempt to examine the quality of the responses and the underpinning logic - or lack of one.

Bruner's (1962) type of creativity would clearly call for something more reality-adjusted than is often required in some measures of creativity. He talks of an act that produces "effective surprise". Such an act, he sees as resulting from combinatorial activity: a placing of things in a new perspective. This type of activity takes individuals beyond common ways of experiencing reality, but his statement assumes, of course, that the subject knows reality in its usual or common forms. This knowledge is essential to the experience of surprise. Bruner's model is, of course, an adult model. One could add as a rider that Bruner sees the "exercise of technique" as a part of the success of combinatorial activity. Technique is both acquired and conscious at some stage.

Other measures of creativity have relied on verbal abilities rather than on the child's response to pictorial images - e.g. Getzels and Jackson's Word Association Measure or Mednick's Remote Associations Tests. Here developmental variations in ways of signifying and of relating would seem to be of importance and yet again there is little attempt to

McKellar, P. (1957) Imagination and Thinking. P.97.

Bruner, J. (1962) "The conditions of creativity" in: Knowing: Essays for the Left Hand.

discriminate against such factors. Bruner and Oliver (1963), for instance, in a study of Equivalence Transformations, noted that with increasing age, there is an increase in functional groupings of objects. Children would appear to attend more to the uses of things than to the structure and appearance of the object. Werner and Kaplan (1952) reported that:

"Many childish words are subjected to the process of conventionalisation till their meanings are fairly congruent with the word content of the adult."

This obviously has implications for the type of tests requiring free associations, for there may well be developmental patterns in signification and association which could affect the interpretation of some results of creativity.

Entwistle's work, cited earlier, is of especial importance here. She studied the word associations of young children in a game-like situation. Her instructions to the children were as follows:

"I want you to tell me the first word you think of each time I read you a word..."

Amongst her findings was the conclusion that children give many more associations than do adults, owing to their lack of language socialisation.

A further difficulty which may blight the assessment of creativity, and an understanding, in empirical terms, of that concept, must be the conditions in which that concept is assessed - the mode of presentation - the test-like circumstances, etc. Rogers and others have emphasised the need for a permissive and playful atmosphere. Wallach and Kogan attempted this and set no time limits - the only limit being when the child showed no desire to continue with the task. However, even in such un-timed

Bruner, J. and Oliver, R. (1963) "The development of equivalence transformations in children", Soc.Res.Child.Devt. 28, 125-141.

Werner, H. and Kaplan, E. (1952) "The acquisition of word meanings: a developmental study", Soc.Res.Ch.Devt.Monog. 15. No.51.

Entwistle, D. (1965) Word Associations of Young Children. P.30

conditions, so-called, there is timing, in so far as creative output is tied to a specific situation and to a degree of motivation and interest on the part of the subject. However, many assessment situations are more demanding than these. Guilford, in his tasks, gives instructions such as:

"In the next 30 seconds write down as many words as you can think of which are similar in meaning..." (Fluency task)

The Torrance tests place specified time limits on responses. Getzels and Jackson (1962) go so far as to print on the test-like instruction booklet:

"... your score will depend upon the number of different words you write, and on the number of different meanings the words remind us of..."

Joan Barker Lunn (1970) made similar demands at Primary School level:

"each item on the test was strictly timed: two minutes was allowed for the majority of items."

Again, one is forced to ask the question - can creativity be assessed? And if so, in what kinds of conditions? Strictly timed tests and conditions of assessment require a subject to "switch on" to creativity in ways which are opposed to the spontaneity and the suddenness contained in so many of the definitions. Assessment of what might be termed normative thinking - where responses are limited and known in advance - is beset by many problems thought to interfere with performance. The assessment of creativity has enormous problems surrounding it - especially when both the subject and the assessor have yet to recognise an outcome as creative. By nature, the outcome cannot be known in advance.

It is with many reservations such as those already outlined - about definition and the relationship of assessment to definition; about the need to distinguish between product and process - that this study has

Getzels, J. and Jackson, P. (1962) Creativity and Intelligence. P.224.
Barker Lunn, J. (1970) Streaming in the Primary School. P.315, Appendix 4.

adopted a largely clinical approach, and, moreover wishes to focus on essential cognitive structures believed to be essential to creative ability. It is extremely difficult - perhaps impossible - to assess creative behaviour in any objective way - but perhaps it is possible to evaluate abilities thought to be essential for creative interpretations of reality.

Guilford (1965) offers a comprehensive theory of intellect and considers creativity within this general framework. He starts from a very different standpoint from that of Piaget - the one applying minimal standardisation and justifying it - the other engaged in multivariate analysis.

Guilford (1967) supports a multivariate view of intelligence (which encompasses creative abilities). His concern is with establishing factors of ability. A factor is initially described in statistical terms by a series of intercorrelations. The next task is to provide a psychological description of that statistic - important, for as Guilford pointed out earlier:

"... where the factor can be given a psychological definition and meaning we have a powerful new concept, not only for descriptive purposes but also for thinking about human nature." (1954)

Crucial of course to this approach to intelligence and creativity is a sound grasp and isolation of the actual factors and the certainty of a factor being a factor! Guilford recognises this problem and notes it as a criticism often employed against this particular method of analysis:

"Resistance to the fact of numerous intellectual factors is sometimes expressed in another way. It is pointed out that additional factors come about by splitting of already known ones. One implication is that there is no end to splitting, and another implication is that splinters cannot be of much consequence. The conception of 'splitting' is erroneous. What usually happened is that early attempts at analysis did not represent all the factors adequately." (1967)

Guilford, J.P. (1965) "A psychometric approach to creativity", Am.Orthopsy. Ass. Symposium.

Guilford, J.P. (1967) The Nature of Human Intelligence. P.36.

Guilford, J.P. (1954) Psychometric Methods. P.471.

Guilford goes on to explain that assurance is attained by means of statistical trials. In general terms, Guilford speaks of a factor as:

"an underlying latent variable along which individuals differ." (Ibid)

Having isolated factors Guilford then places them in his model of intellect:

"The placement of any intellectual factor within the model is determined by its three unique properties: its operation, its content and its product..." (1967)

Guilford explained these three organising principles. "Operation" refers to the kind of action carried out on a given material; "content" describes the nature or kind of material of thought, and "products" are the result of the application of certain kinds of operations to certain kinds of materials. A product could be, for instance, a unit of thought, a concept or a pattern. Guilford has isolated 47 such factors, within which he has a class of abilities which he refers to as 'divergent-thinking abilities', and he sees these abilities as emphasising "searching activities with freedom to go in different directions" (1959, 1950). Guilford has isolated such divergent traits as: sensitivity to problems; fluency of thinking; flexibility of thinking; originality of ideas; the ability to analyse; a basic ability to redefine (a trait inspired by Gestalt psychology) and an ability to penetrate problems. After analysis Guilford found support for his traits, except for the ability to analyse for which no factor could be identified, and though he found a 'penetration factor', he later re-classified this as "cognitive ability".

Guilford's model is a model of the mature intellect. Differentiation of abilities is a function of growth and maturity. The developmental dimension is not treated of by him. If we could do an unlawful mix of

Guilford, J.P. (1967) Ibid. P.65

Guilford, J.P. (1959) "Traits of creativity" in: Creativity and its Cultivation. Anderson, H.H. pp 142-61.

Guilford, J.P. (1950) "Creativity" Am.Psychologist. 5. pp 444-54.

Piaget and Guilford, it might result in a promise of a model of knowing which would include - or rather consist of - a developmental-factorial-dimension or explanation of intellect, including of course divergent factors. Piaget could well be contained within Guilford's three organising principles and these same principles are open to developmental investigation. Meanwhile we have to be content with a developmental explanation of intelligence which promises to include creative dimensions of ability, and with an adult model of intelligence which takes maturity and differentiation of abilities as its starting point.

The study of any problem forces choices. Practical considerations limit dimensions of consideration. Philosophical standpoints direct the initial thrust but there are areas of profitable overlap for research conceptions and methodologies. Piaget, employing what he has termed his clinical approach, offers a wealth of information which gives valuable and essential qualitative insights. Although he himself has quibbled over the word 'test' and refused to standardise, his disciples have employed a certain degree of standardisation. Essentially, Piaget's research is about observation and organised description. Description can be a very free medium. Unless he so chooses, the individual is not bound by categories, though categories might well be extrapolated from the descriptions. This is a qualitative advantage, and in developmental and exploratory type investigations, this kind of unconstrained information is crucial to future accurate consideration. As an interesting exercise Piaget's clinical method might well be regarded as an exploratory, preliminary way of gathering information. The further question must then be how to organise and shape this information. This returns us to the questions: how does one give psychological explanation and meaning to factors which have been statistically isolated, and how adequate are such factors?

An examination of Guilford's factors reveals that there are differences in the nature of some of the factors. For instance, one factor isolated by Guilford is that of redefinition - referred to as "changing Gestalts" in the Koh's Block Test. This is a fundamental ability. Another factor is "originality". This is of a very different order. It is a factor which is more affected by culture and experience, and one which will also be affected by the evaluations of the assessor - even criteria for originality require interpretation. This criticism must lead back in turn to modes of assessing abilities at the initial testing.

Guilford has expressed some concern at assessments which focus heavily on the amount of output, stating that to "score on the amount of elaboration demonstrated can be very misleading" (1959). However, in spite of this, his scoring of certain tasks is largely in these terms. Discussing the Elaboration Task, he says:

"... the examinee is given one or two simple lines and told to construct on this foundation a more complex object. The score is the amount of elaboration demonstrated..." (1957)

This same stress on quantitative dimensions is found in both earlier and later work. Working with Wilson et al (1954), Guilford hypothesised that fluency of thinking would be an important factor in creativity. He regarded this in quantitative terms, concerned with the amount of ideas in stated times.

Guilford's model is very attractive. However, much depends on the nature of the factors, what it is - in psychological terms - that they

Guilford, J.P. (1959) "Traits of creativity" in: H.H. Anderson (ed) Creativity and its cultivation. Harper. pp 142-61.

Guilford, J.P., Berger, R.M. and Christiansen, P.R. (1957) "A factor analytical study of planning abilities", Psy. Mono. 435.

Wilson, R.C., Guilford, J.P. and Lewis, D.J. (1954) "A factor analytical study of creative thinking abilities", Psychometrika, 19, 297-311.

explain or represent, and on what this explanation is based. Goldman (1967) points out that Guilford's tests were each designed to identify or represent a single factor. Torrance soon initiated more complex tests each of which could be scored on several factors.

Piaget would obviously wish to avoid cutting intelligence up into factors - but Piagetian, operational-type tasks could be scored on several factors - in other words - could be presented - generated in wholistic ways and then understood in terms of factor analysis. The underlying comment here is that there is a need, in initial stages of research to give serious consideration to what is being observed and to its assessment. Analysis is dependent upon such work. It is interesting to speculate on the outcome of a Guilford-Piaget type model - a model built of factors of operational ability - allowing a developmental dimension. The first task is to search for factors in qualitative terms. The second is to make factorial sense out of unwieldy Piagetian data.

Few studies of creativity have been truly rooted in Piagetian structural conceptions, in fact the major amount of research in the field has adopted a trait-type approach. David Feldman (1974) argues for a developmental or Piagetian process view of creativity. Feldman states that an emphasis on process focusses on interactional dimensions - between the organism and the environment, with behaviour viewed in terms of changing, acting, constructing constructs. Unlike trait conceptions, Feldman believes that process psychology refuses to see the individual as "a cluster of potentials which determine his future behaviour" (Ibid). Feldman rightly points out that there has been very little conceptual work in this area of process creativity, and even less empirical activity.

Goldman, R.J. (1967) "The Minnesota tests of Creative Thinking", in: Explorations in Creativity. Mooney, R.L. and Razik, T.A.

Feldman, D. (1974) "The Developmental Approach: universal to unique" in: Essays on Creativity. Rosner, S. and Lawrence, E.A.

Essentially, Feldman sets out to draw an analogy between the creative process itself and Piagetian stage formation and achievement. Some of Feldman's inspiration for such an analogy seems to stem from Piaget's own comments on the idea of novelty (1971):

"... for me the real problem is to explain novelties... Beilin (a critic) has made me into a nativist, a preformist, and he has missed the crux of my problem, which is to try and explain how novelties are possible and how they are formed."

Elucidating this point, Feldman explains that Piaget has shown no direct interest in creativity but rather, his reflections on 'novelty' are related to newly completed thought operations, which are unique in the sense that an individual achieves such cognitive organisation for the first time. This present study would argue that Feldman's analogy, by virtue of being an analogy, makes a distinction between 'creative' and other cognitive organisations, and that this distinction should not exist. It is true that each individual has a subjectively unique experience in arriving at various levels of cognitive organisation for the first time, and such an arrival could be described as a "creative" experience; an interesting point, but an inconclusive one, for it is surely through the application of such newly attained cognitive structures that individuals construct creative interpretations of reality. Feldman suggests that such creativity is not necessarily dependent upon public approval, but can be a subjective notion. Duckworth (1972) is in agreement on this point:

"The wonderful ideas I am referring to need not necessarily look wonderful to the outside world... the nature of the creative act remains the same, whether it is an infant who for the first time makes the connection between seeing things and reaching for them... or an astronomer who develops a new theory of the creation of the universe."

Piaget, J. (1971) "The theory of stages in cognitive development", in: Green, D.R. et al (eds) Measurement and Piaget. P. 192.

Duckworth, E. (1972) "The having of wonderful ideas", Harvard Ed. Rev. 42 pp 217-31.

In his analogy Feldman illustrates how universal stages of intellectual development and stages in creative thought have certain common attributes. Briefly, criteria for a stage might well be said to explain the creative process in terms of stabilisation of behaviour, achievement, reversibility of the solution once achieved then application. As an analogy then, it can be said to shed some light on the creative process. It does not make any attempt to root creativity in a structural theory. In fact, having drawn the analogy Feldman then goes on to explain its limitations:

"Creative thought... differs from Piagetian stage achievement first and foremost on the continuum of universality. The Piagetian stages are achievable by everyone, whereas a powerful creative thought is unique not only in the history of the individual (as is the case with Piagetian stage achievement), but in its extreme form is unique in the history of ideas as well."

Analogy is a weak link - if indeed it is a link. This current research is concerned to find unity in conceptions of creative - cognitive functioning and for such an analysis of the genesis of structuring is essential, an aspect to which Feldman gives no consideration.

To conclude, this study attempts to re-define creative ability within the context of operational structuralism. Consequently, some previous definitions have been criticised or rejected, most often because of their narrowness of their statistical, non-explanatory concepts of creativity. The opening part of this chapter dealt with problems of definitions, focussing on approaches to creativity which are concerned more with process or product than with personality explanations. Assessment and scoring problems, regarded as stemming from initial definitions, and the occasional lack of a supporting theory, were discussed and wholly quantitative methods of scoring were rejected, in favour of a method which would take account of qualitative aspects of responses.

Very little research into creativity has examined the subject systematically from a developmental standpoint. Most research has been product-orientated or interested in the supposed intelligence-creativity dichotomy. Some reference was made in this review to early developmental studies of creativity and to more recent work by Torrance. A separate section, in the second part of this research will examine the role of training in creative behaviour.

Mention should perhaps be made of the fact that this research has been confined to what might be termed 'cognitive' aspects of creativity; personality-studies receive little mention. In the last analysis, the reason for selection and focus must stem from the researcher's own interests - even bias. There is no intention, however, of suggesting that personality and group variables are not of importance, but it is argued that cognitive variables are more fundamental to an explanation of creativity. Without an understanding of the construction of reality, no individual - converger or diverger (Hudson) - 'open to experience' (Rogers) or otherwise, can bring about intentional and understood re-constructions. Personality and group factors may well inhibit ability but they are no replacement for it.

PART ONE

Chapter 4

EXPERIMENT AND PROCEDURE

The following section contains a description of the sample and of general preparation. This is followed by an explanation and description of the tasks used in the assessment. Information on both pre-pilot and pilot work is placed next, for it is felt that adjustments resulting from such work will be more fully understood when the final tasks have been considered.

INTRODUCTION

The first part of this research is essentially exploratory. The main aim is to re-define creative ability, attempting to examine this ability within the context of operational structuralism. The following assessment is an attempt to examine the aim empirically.

At its zenith, operational structuralism is concerned with the ability of the individual to reflect upon knowing and upon knowledge. Because of the interrelatedness of intelligence and creative ability within this theoretical framework, it is expected that with age, there will be qualitative differences in responses to the tasks of creative ability.

The notion of qualitative changes in responses, with age, is the only stated hypothesis. Given that the explanation of operational creativity is rooted in that of operational intelligence, and that Piaget has offered much evidence which points to qualitative differences in responses with age, qualitative changes in responses is perhaps less a hypothesis than a stated fact, or accepted knowledge. However, within the field of creativity, such operational notions have yet to be explored. Further, the idea of some systematic form of assessment of creative ability, based upon operational structuralism, has hardly been hinted at by Piaget himself.

A problem of hypotheses is that they give direction. In essentially exploratory work too much direction is to be avoided. However, there are assumptions without which one could not begin to question or to formulate, and these assumptions bring their own constraints to bear upon research design. Amongst them, in this reasearch, are:

- a) dissatisfaction with previous definitions of creativity, especially because of their narrowness and/or context specific natures;

- b) dissatisfaction with previous categories of assessment which have often been biased towards quantitative evaluation;
- c) the lack of an adequate, comprehensive theory of creative thinking; and the implications of this lack for research;
- d) the influence of Piaget's contribution to the theory of knowledge - especially the notion that the mature knower is capable of a high level of reflection;
- e) the influence of Piagetian principles underpinning cognitive organisation, which led to the establishment of related principles believed to govern creative transformations of reality.

In addition to the main hypothesis, there is interest in:

- a) the possibility of a stage explanation of creativity;
- b) the possibility of establishing some systematic method for the assessment of operational creativity.

THE SAMPLE

96 subjects (an equal number of girls and of boys) were included in this first part of the research. These figures do not include subjects who participated in pre-pilot and pilot work. The subjects came from two Inner London Primary Schools and from two Inner London Secondary Schools. One reason for choosing the Primary Schools was that some weight is given, by the schools, to Piagetian philosophy. Children are grouped and taught on a stage rather than an age basis for the most part, and some assessment of progress is carried out by means of Piagetian type tasks. Though there was a somewhat more formal approach in the Secondary Schools, most of the children in the sample, had in fact been pupils in one of the Primary Schools and because all of the Secondary School children were in

pre-examination classes, there was still a fair degree of informality in their school experience. Most of the subjects came from homes where parents fell into Social Classes 3 or 4 (Registrar General's Classification).

The subjects were divided into the following age bands with an equal number of boys and girls in each:

- 6-7 years of age (24 subjects)
- 8-9 years of age (24 subjects)
- 10-11 years of age (24 subjects)
- 12-13 years of age (24 subjects)

Selection of Subjects

In the selection of the subjects, no standardised IQ test was employed. The concern was with operational ability (which is not regarded as distinct from operational creativity) and not with accrued knowledge. It could be argued therefore that sub-tests from, for instance, the WISC could have been employed in selection, but as concern was not with concepts such as "IQ", a system of teacher rating was thought to be adequate and was adopted as a method of selection.

The schools involved either worked on a Team Teaching basis (Primary) or had some inter-disciplinary work (Secondary). In both cases, all children in both schools were well known to at least three teachers. Consequently, three teachers, involved with each of the children were asked to rate the children in their Team, Class or Group on the following five point scale:

below average just average average good average above average

Children who were rated as "good average" by at least two of their teachers were listed for selection. The first 6 boys and the first 6 girls so rated in each age group were included in the sample. Teachers had been

asked to rate children on their general performance as opposed to ability in any one specific area.

Reading scores were also considered because of the verbal ability required for some of the items. The gap between chronological and reading age was never allowed to exceed two years in advance of chronological age.

PREPARATION AND METHOD

Pre-pilot and pilot work was carried out in all of the schools involved in the research. I spent six days across the four schools engaged in this work, and a further two days working in the schools, with groups of children on school projects. This was done deliberately to become known to and more accepted by potential subjects.

A full explanation of the research was given to the teachers after they had rated the children for selection. The children were told that I was interested in finding answers to a number of problems and puzzles and that I would be grateful for any ideas they had. No-one was obliged to take part - but no child refused. Older children were given a slightly different explanation in that it was couched in more sophisticated terms. It was stressed that this was not a test in any sense and that the results would not be given to the school or to their teachers. The task items were not presented in test-booklet form, but on separate sheets on paper. Papers given to the children bore no official-looking headings, e.g. spaces for names, numbers, etc.

School interviewing rooms and school libraries were used for the assessment, on the whole bright informal kinds of rooms. During the first part of the assessment, when the tasks involved drawing, there was a background of music. The examiner appeared to have other tasks in hand when

the subjects were drawing - as it was thought to be restricting to 'watch' the subject. However, detailed observations of remarks and actions were made. Younger subjects sometimes left the table and walked about the room between items. This was allowed.

For some items (verbal) a tape recorder was used. The machine had an internal microphone and was switched on and off discreetly from a wall switch beneath the examiner's table. No reference was made to it.

Generally, there was a non-evaluative attitude. Attempts were never criticised and 'errors' never commented upon. Younger children sometimes raised quite different subjects for conversation. These were taken up and the child was steered back to the tasks as possible.

An attempt was made to avoid discussion of tests between subjects before they were tested. This was effected by not interviewing any one age group at a time, but by moving across age groups, trying to separate subjects by means of timetabling and age and team membership. In fact, observations showed, that the younger subjects were incapable of explaining the details of the tasks to their fellows - so distorted were the explanations overheard!

Minimal note-taking was carried on in front of the subject. Notes and numberings were made immediately after each session. Tape transcripts were carried out each evening before the next set of interviewing.

Each interview took at least one hour on average, with some slight variation up to about one and a quarter hours.

This lack of strict time limits both for the individual items and tasks and for the assessment as a whole is in keeping with the essentially clinical method employed. Though the tasks were standardised as such,

in exploratory research the aim is to allow maximum freedom of response to the subjects. Consequently, individual comments and approaches were followed up or allowed respectively and time limits were not imposed.

Principles Underpinning the Tasks

In the introductory section to this research, the principles believed to underpin transformations of reality were outlined. These principles were arrived at after a consideration of the kinds of transformations of reality believed to be possible and in the belief that creativity must begin with existing realities which, when transformed, can lead to new creative outcomes.

A more detailed explanation of these principles is now offered below:

A1 Apprehension and re-definition of reality: An initial step in all re-structurings is that of apprehension and re-definition of the identity or structure involved. Definition is regarded as an index of apprehension, and re-definitions will vary according to apprehension and re-apprehension of the problem. Handling of identities will vary according to ability to define and re-define, for according to the manner in which the object is initially perceived, so it will be related and re-constructed. All identity transformations are dependent upon this ability to apprehend, define and re-define. This initial process is one of conceptualisation. The following processes, in their different ways, all involve changes to the initial concept.

B1 Re-structuring or re-organisation of component parts: Without adding to or detracting from the identity, an individual will re-organise the parts of that structure (or structures) to arrive at a new conclusion or a modified structure.

- B2 Addition to an identity: Here the individual defines an identity and on the basis of that definition, adds to it in a way which will incorporate it into another identity or create a further identity.
- B3 Subtraction from an identity: By removing part of an identity, a subject is able either to modify an existing identity or to produce a new identity.
- B4 Multiplication or increase of identity: This transformation would include increasing the size of an identity or increasing numbers of identities to arrive at a different conclusion.
- B5 Division of an identity: This would involve a fundamental structural change in an identity. Divisions would take place according to the manner in which the structure was initially perceived. Divisions could be equal or unequal.
- B6 Relating and re-relating of identities (including combination and synthesis): When identities or component parts of an identity are re-defined in relation to one another they can lead to a formation of a new identity. Re-structuring or re-organisation was concerned with all the component parts of an identity; re-relating has its focus upon the outcome(s) of re-relating or fusing some of the component parts of an identity or system of identities.
- B7 Adjustment to an identity: This process requires modification of existing component parts or of the whole identity - e.g. change of colour, bending of form, etc.

Each of the principles can be applied to 'convergent' as well as to 'divergent' transformations of reality. In the one, the task parameters and outcomes will be specified, in the other they will be discovered and recognised. Knowledge of 'convergent' transformations based on each of

the principles is essential, if the same principles are to be knowingly applied to 'divergent' transformations.

TASK CONSTRUCTION

In the construction of tasks for assessment, a frequent problem is that of selection and ordering of items. Such a process of selection is normally concerned with the nature of the items, the skills required to carry them out, and with what might be termed the "degree of difficulty" of the items in relation to one another.

Within the context of operational structuralism very different questions need to be posed and examined. An act can be understood and carried out at many different levels of cognitive understanding, according to the state of cognitive maturity of the knower. Concern is then not so much with the selection of appropriate items and their placement in order of ascending difficulty, but with attempting to identify levels of cognitive organisation in responses to the tasks, and in so doing, move towards identifying the levels of a task which are attainable at different stages of maturity.

Every event or object will be constructed by the knower according to his ability to understand that object or event. Knowing moves from simple to complex, and every act of knowing can be seen as having "levels of complexity". An object may be elaborated upon. It may also be added to or modified in some way, and each of these different transformations can take place at different levels of understanding. The question for operational structuralism is not - can a child elaborate or divide? - but at what level can he divide or elaborate, and how does one identify tasks levels across different tasks?

Piaget has obviously provided much ground-work here, focussing as he does upon the nature and quality of responses, but he has resisted systematisation of a kind which might have led to the establishment of a scale of assessment, and to precise comparisons across different areas of development. This is partly due to the fact that he has been very context-specific in his classifications of responses to tasks. It is clear, for instance, that both moral judgement and language development can be described in terms of a movement from ego-centricity to a more objective state, but because Piaget's categories of description have generally been context-specific, it has not been possible to find precise corresponding levels across different, yet fundamentally related, areas of development.

This matter of "task-levels" was a key issue both in the construction of the tasks and in the subsequent construction of categories for their assessment. The final section of this research discusses the idea of a tentative scale for the assessment of operational creativity based on this notion of task-levels.

In the construction of tasks, for this research, focus was not on an end product or outcome, but with ability to interpret and to re-interpret reality. There was a need to construct a series of tasks which would make possible the study and observation of such ability. Further, these tasks, which embody the principles believed to underpin creative ability, could not be context-specific. The intention therefore was not to assess "figural creativity" or "verbal-creativity" (if there are such things) but to attempt to see if individuals could understand and operate upon essential underpinning principles. For instance, as will be seen, adjustment (a principle) is not something which must be tied to verbal assessment, or assessment in a particular medium. An individual may be skilled in the application of this principle in a particular medium, but here, focus was upon a grasp of the principle - not upon the ability to handle the medium. Consequently, the tasks could not require a high level of skill

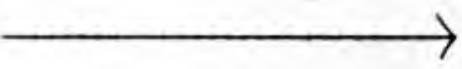
in a particular medium, and assessment would have to focus upon ability to operate, to understand, and not upon skill or upon presentation. Tasks would also need to be suitable for a wide age-range for there is no particular task for particular ages; the distinction is in the nature and quality of the responses to the tasks. An attempt was made to maintain a balance between verbal and non-verbal tasks.

Whilst changes in the nature of responses were anticipated as a function of age - the question of "stage" in the Piagetian sense could not be ignored. However, whilst the notion of stage is generally assumed within this explanation of creativity, it is not possible, as will be explained later in this research, to arrive at adequate and final categories for the description and assessment of stages of operational creativity on the basis of this very exploratory research. This is not, however, to deny a movement in that direction or to suggest that no such tentative conclusions might be drawn.

The matter of stage was borne in mind during the construction of the tasks. Can one speak of concrete or formal creativity? Ought tasks to be constructed with such questions in mind? Simply, whilst one can speak of 'concrete-creativity' - essentially a description of a response - there are no particular acts or activities which lend themselves or properly belong to concrete or formal creativity. Such "stage-labels" are comments on levels of cognitive organisation. A task may be presented to a subject in a 'concrete' form. By this might be meant that a number of concrete props are employed in the presentation. However, an individual who brings to bear upon such a task, a formal operational quality of thought, will execute the task with an understanding and reflectiveness not possible to the concrete operational thinker. In other words, it is not the task which earns the label "concrete" or "formal", or "normative" or "creative" for that matter, but the response to that task which can vary in qualitative terms.

Accordingly, any conclusions about stage must be based on the analysis of responses, and the categories generated for such an analysis will be of prime importance.

A final point needs to be made concerning the principles of creativity believed to underpin creative transformations. All creative transformations are governed by one or more of these principles. Therefore, these many different creative expressions can be classified, according to these principles, and, at a certain level, their apparent diversity and differentiation reduced. All principles can be acted upon with increasing understanding and reflectiveness. All creative transformations could therefore be classified as follows:

Principles	A continuum from inability and ego-centrism, to formal, reflective ability.
Re-apprehension and definition	<div style="text-align: center;"> <p>- task levels +</p>  </div>
Addition	
Subtraction	
Multiplication	
Re-relating	
Adjusting	
Division	

A more detailed discussion of this tentative system of classification is given in the final chapter of this research.

In conclusion, Piagetian principles of organisation have been concerned largely with normative organisation (e.g. seriation, correspondence), but the structures underpinning the principles are the structures which underpin creative transformations of reality. Indeed, creative transformations are dependent upon normative transformations. They are an

integral part of the structural explanation of intelligence as propounded by Piaget. However, whereas Piagetian principles tend towards normative logical organisation and reflection upon such, the principles underpinning creative transformations tend, when applied to more open-ended tasks, to lead towards re-organisation and to reflection upon such.

A list of the principles as they relate to each of the tasks is presented below:

Task	Principle(s)
ELABORATION TASK	Addition (non-verbal)
FREE PROBLEM SOLVING	(i) Re-organisation (non-verbal) (ii) Re-relating of identities (verbal)
RECOGNITION OF IDENTITIES	Definition/re-definition (non-verbal)
IDENTITY RE-CONSTRUCTION (1)	(i) Definition (verbal) (ii) Re-organisation (non-verbal) (iii) Division (non-verbal) (iv) Re-organisation (non-verbal)
WHAT WOULD HAPPEN IF TASK	(i) Re-organisation (verbal) (ii) Re-organisation (verbal)
RE-CLASSIFICATION	Re-relating of identities (verbal)
IDENTITY RE-CONSTRUCTION (2)	(i) Definition (verbal) (ii) Re-organisation (non-verbal)

All transformations governed by these principles could lead to novel conclusions. Conclusions are always attained by the manipulation of what is known, to arrive at what is not known and what requires recognition and identity.

THE TASKS³ AND THEIR ORDER OF PRESENTATION

In presenting the tasks to the subjects, an attempt was made to vary pictorial and verbal items and to separate items which might be thought, by the child, to be similar.

The tasks, explained on the following pages, were presented in the order given below:

1. Elaboration Task

(it was thought that a pictorial type test might be regarded as 'easier' by the subjects, and was therefore placed first) (PLATES 7 and 8)

2. Free Problem Solving

3. Recognition of Identities (PLATES 9 and 10)

4. Identity Re-construction (1) (PLATE 11)

5. What Would Happen If Task

6. Re-classification Task

7. Identity Re-construction (2) (PLATE 12)

Each item was presented on a separate sheet of paper. There was no space on the sheets for the subject's name or for any type of coding. This was done deliberately to avoid the impression of a test. Each subject was interviewed alone.

Materials: the task sheets
 black pencils

1. The Elaboration Task

This task is influenced by the work of K. Franck (Drawing Completion Test, 1952) and that of Wallach and Kogan (1965), though the assessment is different in nature. The intention is to see how the child will elaborate at different ages, and to see if there are any patterns related to age which might emerge.

Each of the stimulus lines was presented twice in order to enable the subject to become more familiar with its form and thus have a firmer grasp of its identity and its potential. Each stimulus line was presented on a separate sheet of paper.

The task was explained as follows:

"I want you to have a look at the lines on this sheet of paper and see if you can turn them into something really interesting by adding lines. It can be anything you like. Turn the paper around and look at it from different angles like this (Examiner turns paper around) and then you might get another idea."

After the subject's first attempt, the examiner continued:

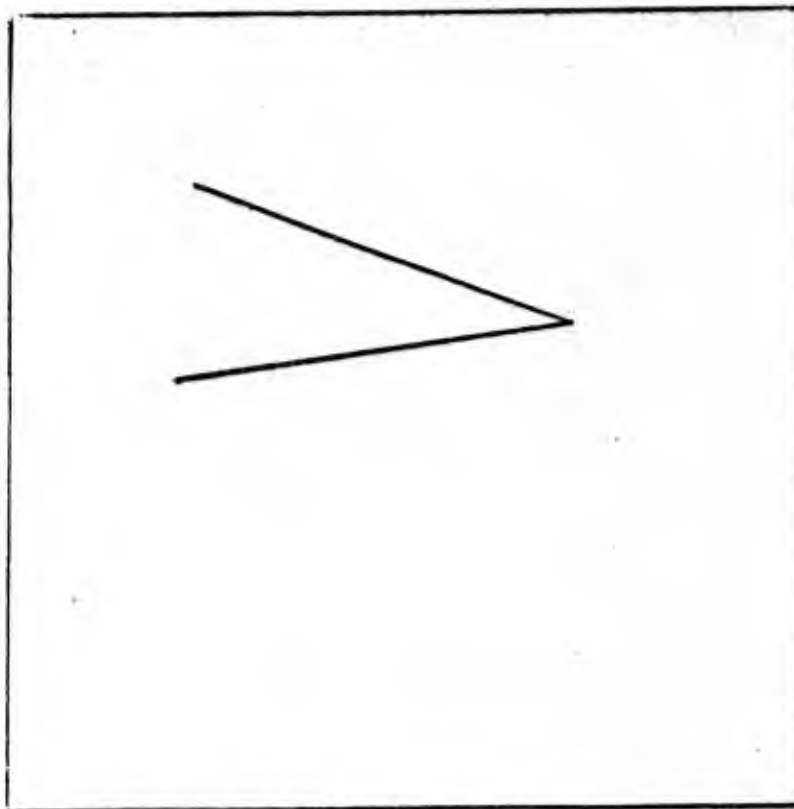
"Now see if you can make something different out of the second set."

Questions put by the child were answered and, as necessary, the above information was repeated as the child thought or drew.

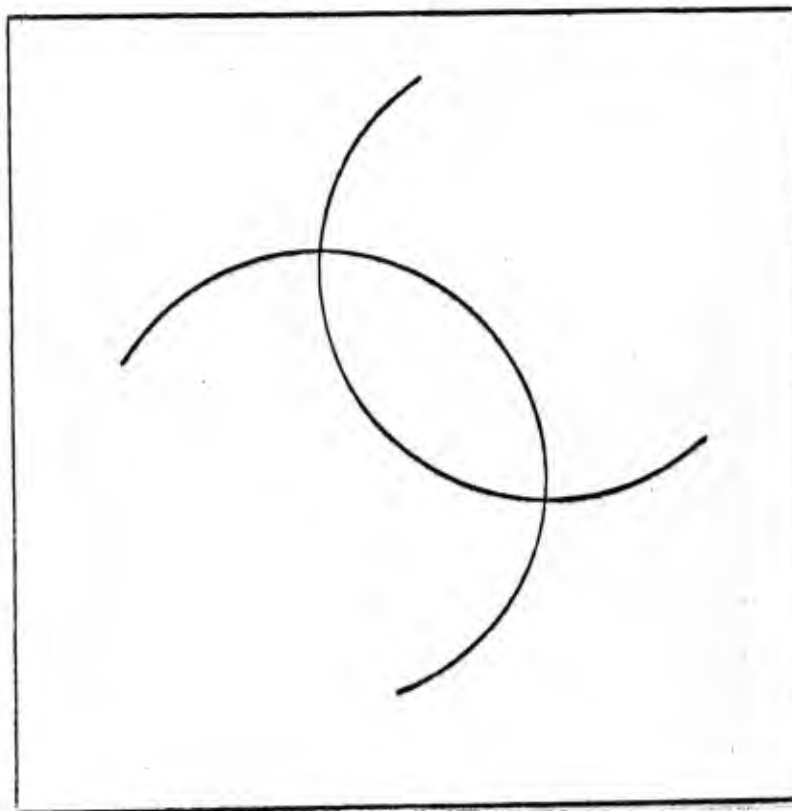
The child was always asked to name what he had drawn.

Though it was not in fact employed, a practice stimulus line had been prepared in case a subject found it difficult to understand the instructions.

The four stimulus lines used are presented on the following pages.
(PLATES 7 and 8).

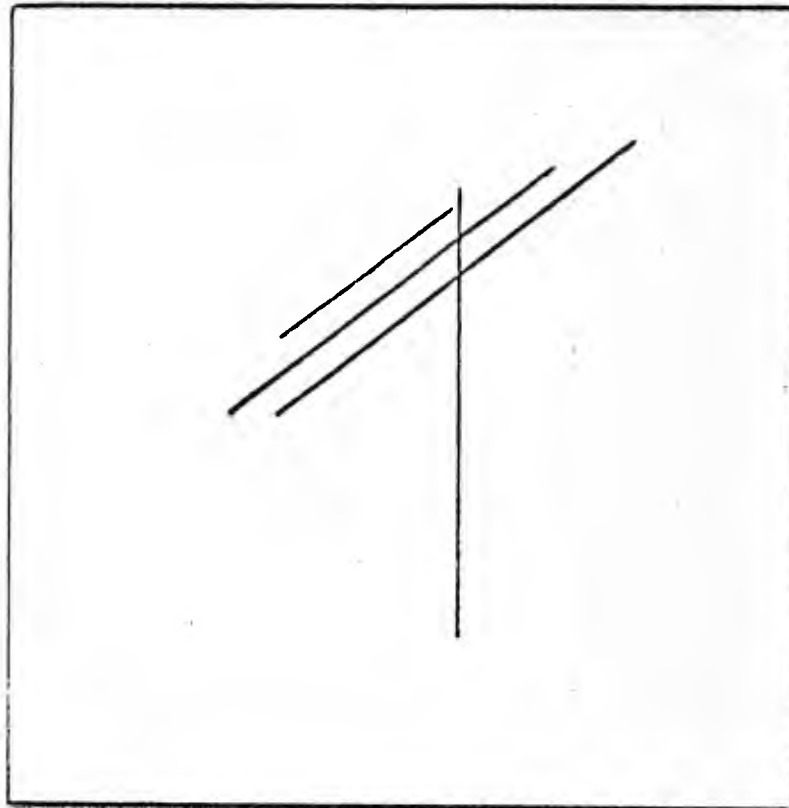


item. 1.

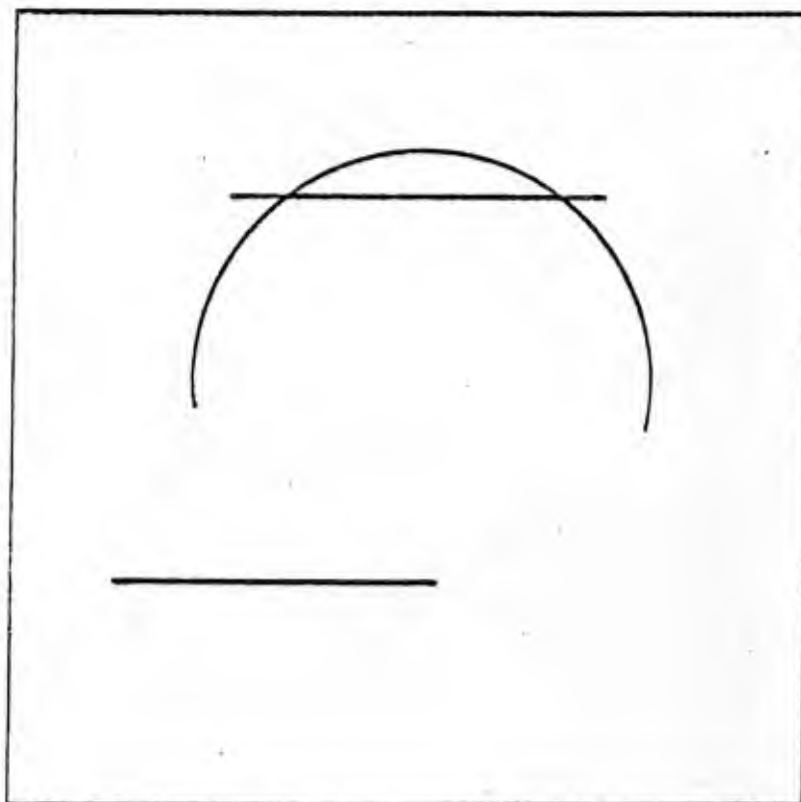


item. 2.

Items (exact size) used in the ELABORATION TASK. Each item was presented twice and could be used from any angle by the subjects. there was no strict time limit.



item. 3.



item. 4.

4 items in all were used on the ELABORATION TASK. Again these couldbe used from any angle by the subjects.

2. Free Problem Solving

This task was influenced to some extent by the problem-solving work of Wertheimer and Scheerer (1945 and 1963), and that of de Bono (1972 and 1975) with his open-structured problems. Such influences led to a task described as Free Problem Solving. No one solution is required and the intention is to see how children, at different ages, will handle the problem.

The problems were presented in the following ways:

a) Matchstick Problem

In the case of younger subjects, it was first established that they knew what a triangle was. This was done by asking them to make a triangle out of three matchsticks.

"Now I would like to see if you could make a triangle out of these four matches. You can do anything you like with the matches."

Throughout the child was encouraged to: "use the matches in any way you like".

"Now let's see if you can make another triangle using the matches in a different way."

Some subjects asked if they could break the matchsticks and were told that this could be done.

The subjects worked on a flat board.

If subjects showed any signs of not understanding the task, the Examiner asked them to look carefully at the triangle made out of three matchsticks and asked them to think about how they could add the fourth and still have a triangle. Most subjects began with this paradigm - simply adjusting the three matchsticks until the fourth could be fitted in.

The Examiner recorded the child's efforts on a sheet divided into numbered blank squares. The child was told that this recording was for him in case he wanted to check his own efforts.

b) The Bottle Top Problem

The child was presented with a picture of a lemonade bottle with a tin top. This was in case subjects assumed that the bottle could have a screw top. The card remained with the subject throughout the item.

The child was instructed as follows:

"Here's a picture showing the top of a lemonade bottle with a tin top on it. I want you to see if you could invent a new way of taking these tops off the bottles. Perhaps you could think of a new machine or a new little gadget that would take tops off bottles."

As needed, the child was asked questions about his explanation - e.g.

"I see, and how would this lever work, etc."

the purpose of the question was to see to what extent his response was related, and whether or not the child was able to grasp the implications of his suggestions and carry his ideas through.

Younger subjects sometimes began by offering already existing solutions. These were accepted (though not recorded for assessment) and then the subject was, once again, encouraged to think of a solution which did not exist.

3. Recognition of Identities

This item was developed from Cattell's Objective (O-A) Analytic Anxiety Battery Test (1960) and Witkins Embedded Figures Test (1957).

The task is divergent in nature in that there are no pre-defined hidden shapes to be discovered. The intention is to see how and what the subjects will recognise and structure at different ages.

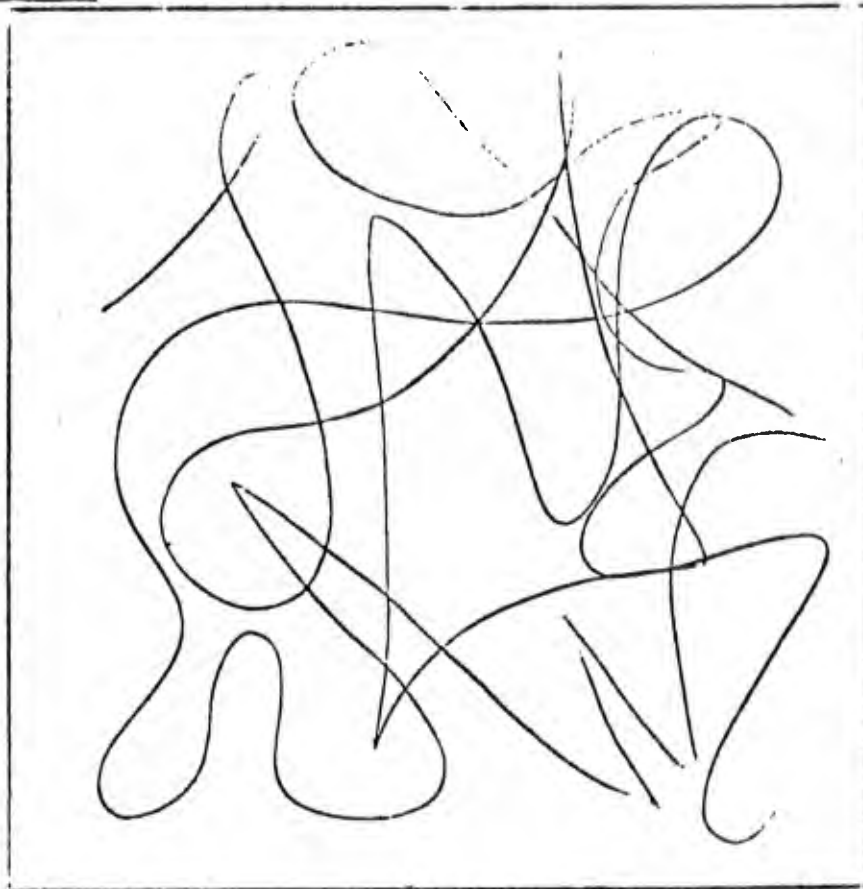
Again, each set of lines was presented twice to the subject, to enable him to become familiar with them in his attempts to perceive new possibilities. As with the earlier line task, a practice item was prepared for subjects who might have difficulty in understanding the actual task. The lines were deliberately different from any employed in the actual assessment items. They were used with about half of the 6-7 year old age group. In this case, the Examiner picked out shapes, thickened round the lines and added minor details.

The main tasks were put to the subjects as follows:

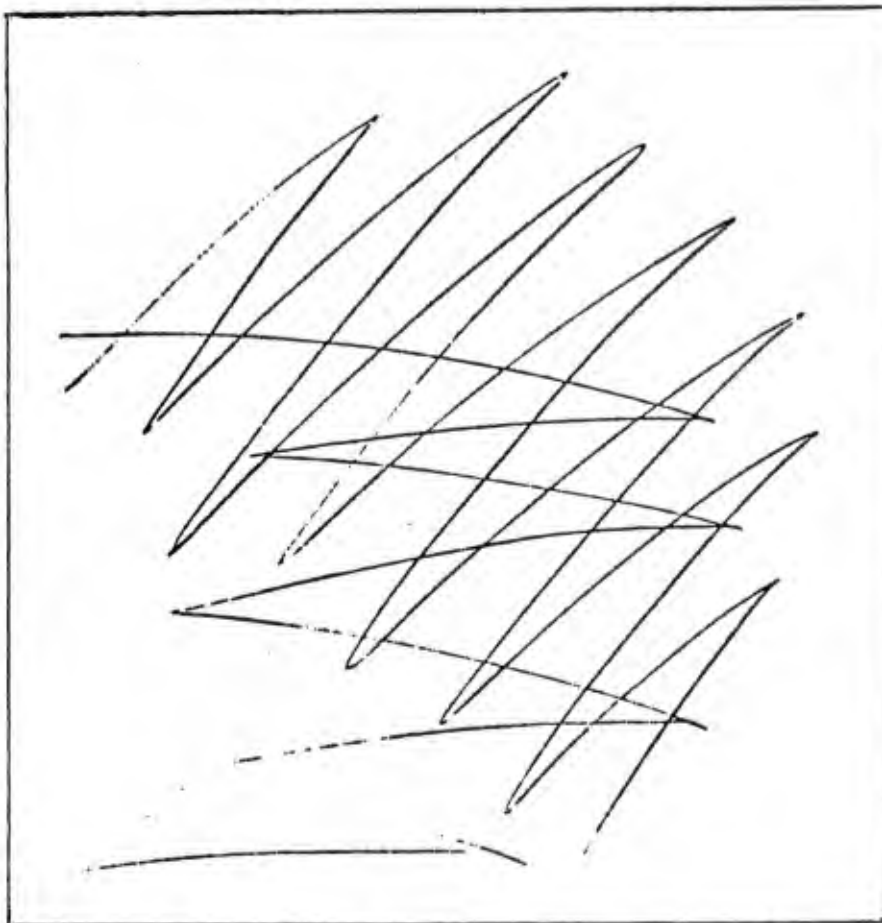
"Now here are some lines. Have a look at them and see if you can find any interesting shapes or objects hidden in them. It can be anything you like, and you can add small details. Just thicken over the lines so we can see what you have picked out."

"Now see if you can get something really different out of this second set."

The three items used in this task are presented on the following pages (PLATES 9 and 10).

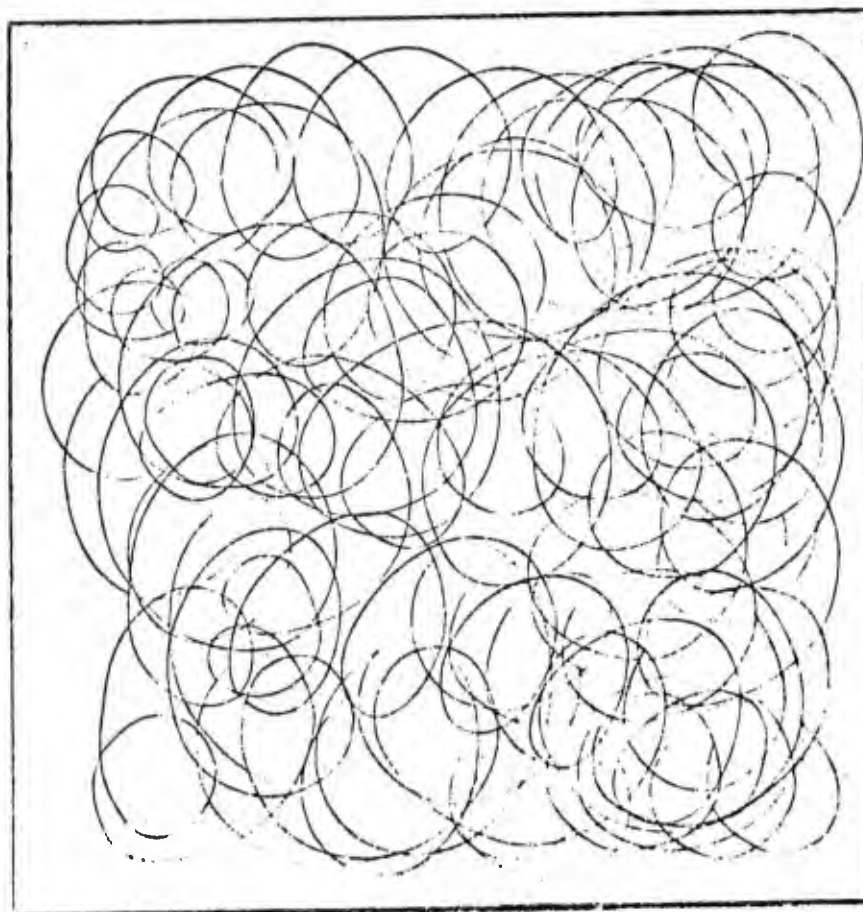


item. 1.



item. 2.

Items (exact size) from the IDENTITY RECOGNITION TASK. Each item was presented twice and could be used from any angle.

PLATE 10

item 3.

The 3rd and final item from the IDENTITY RECOGNITION TASK.

As with the Elaboration Task Items, each item was presented alone twice on a sheet of A4 paper, but in the frame outlined above.

Subjects worked with one colour (black) only.

4. Re-construction of Identities (1)

These tasks are developed from the work of Piaget and his followers. The roots are in Piaget's notions of object-concept, conservation and operational ability. These tasks are seen as fundamental to creative knowing for they require the subject to act upon materials, to transform them and to give some explanation of his transformations, thus indicating his consciousness of his own activity. Both tests require that the subject have a sound grasp of the structures before him, in order to be able to re-structure. A reproduction of the card used in this task is presented over the page (PLATE 11).

The tasks were presented as follows:

Item 1: Definition

"On this card is a diagram of a block of flats. This is the ground floor, here (indicates) and here (indicates) you have the other floors. The windows on the ground floor are round, all the others are square. Now I want you to imagine that I don't know what is on the card - I can't see it, and I want you to describe to me what is on it. I need to know exactly what is on the card."

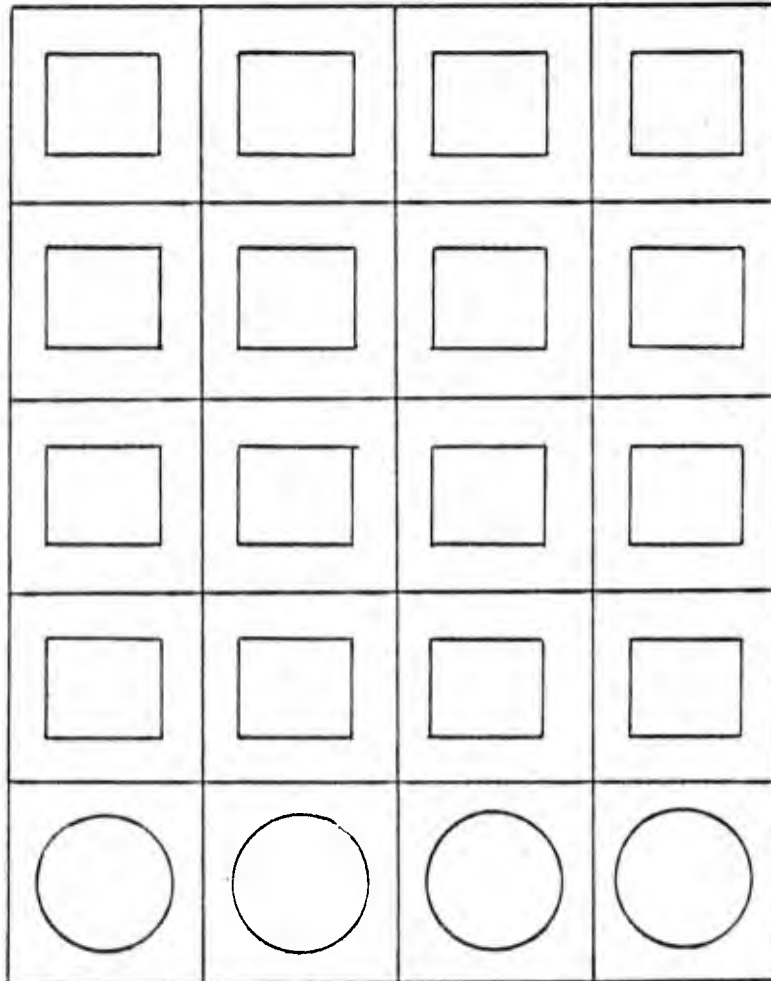
Slightly different wording was used with younger subjects who enjoyed the idea that the card could not be seen, and most hid the card from the Examiner in some way.

After some description:

"That's fine. Now do you want to add anything else?"

No comment was made when information was distorted or not given.

IDENTITY RE-CONSTRUCTION (1). all items.



- item 1. Ss. were asked to describe what was on the above card.
(exact size. test card = orange)
- item 2. Ss. were asked to change the building in some way, using
all the units above and adding nothing.
- item 3. Ss. were asked to turn the building into two unequal ones -
each different in some way - using only the above units.
- item 4. Ss. were asked to change the shape of the building using
only the units above.

all responses were drawn by Ss. there was no strict time
limit.

Item 2: Re-construction

"Now, I would like you to draw this block of flats so that you make it look different in some way. You have to use all the blocks shown on the card and you can't add anything, but somehow you have to make it look different."

Information was repeated as necessary, but no cues were given. The rules of the problem were repeated to confront the child, whenever he seemed to be ignoring them - e.g. "No, you can't add a door" etc.

Item 3: Division of Structure

"This time, I would like you to re-build the building but I would like you to make the building into two buildings - you have to get two buildings out of this one building. And once again, you can't add anything, and you have to use the blocks shown on the card. Also, each of your two buildings has to be different in some way, with a different number of squares in each.

Questions were answered.

Item 4: Shape

"Finally, I would like you to show me how you could change the shape of the building. The rules are the same. You can't add anything and you have to use all the blocks shown there, and yet you have to change the shape."

After all three tasks, the subject was asked to compare his own efforts against those of the model, to test his awareness of his 'deviation' from that model.

5. What Would Happen If Task

This task is inspired to some extent by the Torrance Tests of Creative Thinking (1974). The aim is to attempt to remove some of the constraints of our own system of reality to see how children at different ages will attempt to cope with the possibilities of a new system. It may be that with age there is a decrease in brief unrelated responses, which lack implications.

Two questions were presented separately to the child, as follows:

- a) "What would life be like if there were no such thing as night - if it were day all the time?"
- b) "What would life be like if there were no such thing as talking - if men didn't speak?"

Again, there was no time limit. The questions were repeated as needed. All responses were recorded by means of a hidden tape-recorder.

6. Re-classification Task

This task was influenced to some extent by the word association tests of Getzels and Jackson (1962) though the exact purpose of this present task was different. Here the subject is asked to group and re-group words and ideas placed before him. Interest is in the subject's ability to classify - to seek out and to establish new criteria - and not with a presentation of learnt classifications (Piaget and Inhelder, 1964. See note (i)).

Piaget, J. and Inhelder, B. (1964) The Early Growth of Logic in the Child.
Note (i) (from the above work, P.289)

"A change of criterion of 'shifting' is simply another expression of operational, and therefore reversible mobility, this being the hallmark of a complete classifactory system."

Subjects were presented with the following words, in the order shown, on a card 10" x 10". The words were typed in jumbo size type.

TREE	ANGER	COOL	CLOUD
SHADOW	GREEN	MUSIC	LIFE
STOP	SMOOTH	PEACE	FEAR
RED	BARK	KNIFE	FLY
NIGHT	BLUE	STONE	ROUND
PUNCH	SHELL	PAPER	WATER

In addition, the subjects were also given a set of small cards (3" x 1") each card bearing one of the printed words:

SMOOTH

This enabled younger subjects in particular, for they were able to work with the cards moving them around as they sought for possible relationships. These cards were also typed in jumbo type. The vocabulary on the cards was checked with the schools to see if it was suitable for the age groups involved.

The problem was presented to the subject as follows:

"On this card you'll find a list of words, and you'll find the same words on these small cards. Have a look at this list here and see if there are any words which you think could go together in some way. You could use these small cards - move them around - and put them together when you think the words could go together."

An example was given by the Examiner to make sure that the child was clear. The youngest subjects were first asked to read the list of words on the card to establish familiarity with them.

After a grouping had been offered, the Examiner continued:

"Now, could you find some more words that go together. Try to use different words, but you can use the same ones again if you wish."

There was no time limit.

The Examiner ringed the words on a record sheet as the child made the associations. Reasons for the associations were also recorded. The child was told that the recordings were to help him remember associations he had already made.

All associations were recorded - even bizarre or 'wrong' associations. No comments were made upon the responses by the Examiner.

7. Identity Re-construction (2)

The rationale of this task has already been explained under Re-construction (1). The Test Card employed in this task is shown on page 144.

There were two problems in this task which were presented as follows:

a) Definition

The child was shown the test card with an outline of a square and a leaf.

"Now I would like you to describe to me exactly what you see on this card. Imagine that I can't see the card and that you have to tell me everything about it before I can know."

b) Re-Construction

"Now, I would like you to make an object or a design using the pieces on this card. In your mind break up the pieces that make up the leaf and the pieces that make up the square and mix them up to make a new design or object. It can be anything you like. But you can't add anything and you have to use all the pieces here."

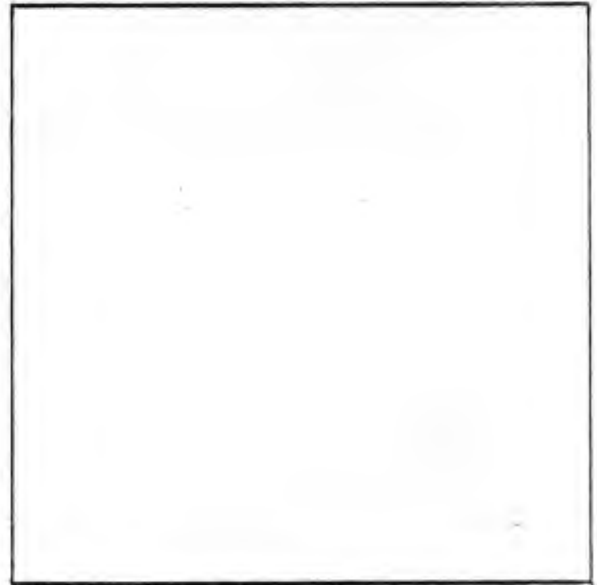
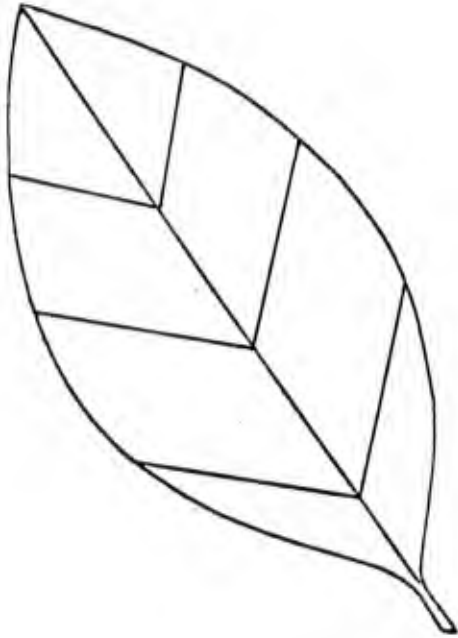
Then at the end, when we look at what you've done, I shall say to you: 'Now show me where you got this line from and you will have to say - it came from here (indicating)' etc."

The explanation was repeated until the child seemed to be clear. A more sophisticated explanation was given to older subjects.

Subjects' efforts were always compared with the model and comparisons drawn.

Again, there was no time limit.

The task card is presented on the following page. (PLATE 12).



Item 1. The leaf and the square were presented to the subject on a card $8\frac{1}{2}$ " X 7" (actual size & position as above). Ss. were asked to describe what they saw on the card as accurately as they could.

Item 2: Ss. worked from the same card. This time they were asked to re-structure the lines and forms on the card in order to make a design or object. They were told that they had to use all the lines on the card once and that they were not allowed to add to the lines.

The information on the card was deliberately limited in the interests of younger Ss.

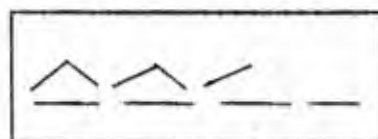
PRE-PILOT WORK (Part 1)

Additional details of pre-pilot work are to be found in Appendix I.

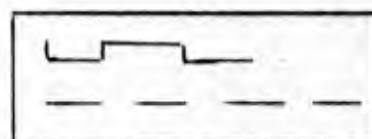
Conservation Tasks

Some initial pre-pilot work revolved around the concept of conservation. Creative re-structuring requires that an individual have the ability to form an accurate concept of the reality to be transformed. Rather than simply assume the validity of much of Piaget's work, it was believed that it would be of value in the construction of creative ability measures, to explore empirically, relevant aspects. Conservation is one instance of a construction of reality, and Piagetian work has illustrated developmental trends in the formation of the concept. One intention of this conservation inspired pre-pilot work was to see if, with certain aids, and under different conditions, children of different ages would be able to grasp shape changes realising that other dimensions were remaining constant. The work of Hermina Sinclair (1973) was adapted for explorations of length conservation.

As well as being faced with some classical conservation questions, the subjects in pre-pilot work were required to imagine certain shape changes, to describe and to explain the outcomes and to consider the implications.



Types of cards used.



Matchsticks were real.

Children were provided with matchsticks to work out solutions.

Sinclair type questions were posed, e.g:

"Which would be the longer road if you flattened out the matchsticks?"

"Why would this be so?"

This pre-pilot work which involved 12 subjects, selected on Teacher Ratings (see Note 1) - two representing each of the age groups finally studied - gave rise to the Identity Re-construction Tasks for creative re-structuring involves understanding the implications of change to a structure.

The Picture Task: Subjects were shown a large picture 12" x 18". The picture depicted a house in the background, a garden with trees and bushes, and two children. The questions posed around the picture were intended to see if the child could conceive of things from the angles of those in the picture and also under changed conditions (important to creative re-structuring). The type of question put was as follows:

- a) What can the girl/boy see from where they are?
- b) If they were in the house looking from this window, what would they see?
- c) If it were winter what would they see (i.e. no leaves on trees would allow clearer views)?
- d) If the boy were hiding in the bushes, what would he see? etc.

After each question the child was asked "why?"

The House Task: A similar task was given this time using a cardboard doll's house, 1 foot high, two small dolls and a small car. Figures were placed in different positions and questions aimed at examining the child's ability to:

- a) place himself in the positions of others;
- b) conceive of the scene under changed conditions and grasp the implications of the changes.

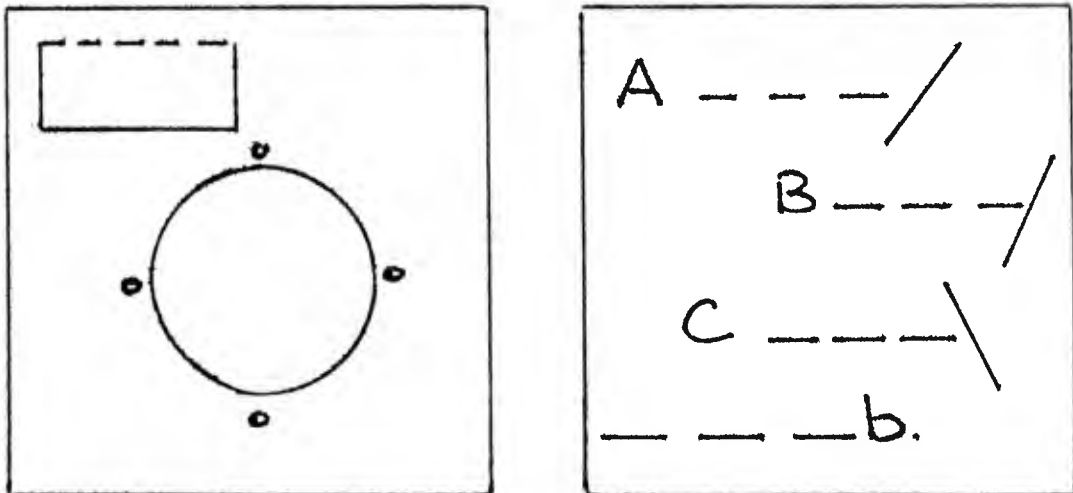
These tasks gave rise to questions which were eventually chrystallised into "What Would Happen If Tasks".

Note 1: A method of selection based on Teacher Ratings was employed in the main part of the research. An explanation of the method was given earlier in this chapter.

Definition and Comprehension Task

Essentially in this task the child was asked to describe as accurately as he/she could what was on the card. In order to motivate the child, the task was played in the context of a game, with three other children drawing what was described and trying to do so as accurately as possible. Essentially, interest was in the organisation of what was perceived by the subject describing the card.

The Cards:



The actual size of both cards was 6" X 6".

These tasks gave rise to questions in the Identity Re-Construction Tasks (1 and 2).

RE-CONSTRUCTION TASKS (with concrete props.)

This was a task more immediately related to the final research tasks and one which helped towards the construction and modification of the Identity Re-Construction Tasks (1 and 2).

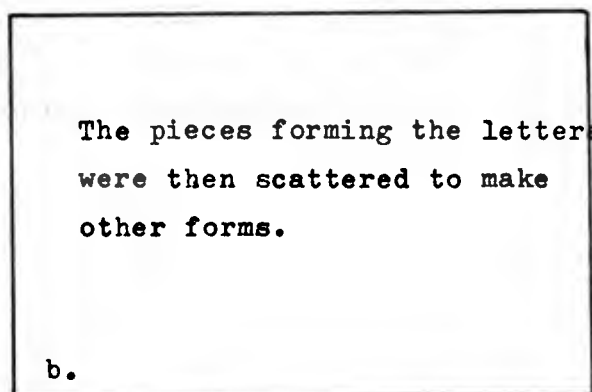
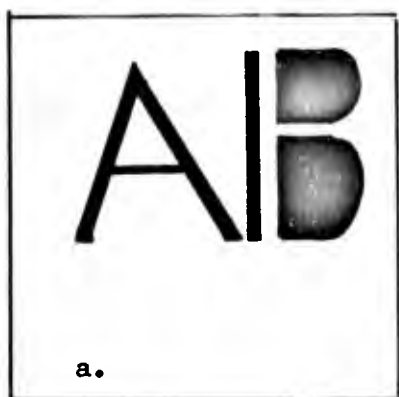
Material: A card with the Letter shapes A and B (8" x 8")

A blank card (working board) - (1' x 1')

The pieces forming the letters A and B - as depicted on the first board.

Subjects were required to:

- a) Construct further named shapes out of the shapes of the pieces of the letters.
- b) Construct any further shapes they could think of.



It was thought at first that a task of this nature (especially because it is 'concrete' in presentation) might be necessary for younger subjects on the grounds that they would be quite unable to manage the Re-construction Tasks without such concrete props. This was not in fact so as evidenced by their responses - in the sense that they could grasp the requirements of the tasks. It was decided further that to provide the subjects with such shapes (as above) was in fact to provide them with 'definitions' of forms and to prevent them from 'dissecting' the parts themselves, according to their own definitions. This intended mode of presentation was consequently dropped.

PILOT WORK (part 1)

28 subjects took part in the actual pilot work. There was an equal number of girls and boys and four subjects (2 boys and 2 girls) represented each age range (from 6-13 years). Their responses were not included in the final results. The subjects were selected from the schools employed in the main part of the research and the method of selection was the same.

The pre-pilot work had been very exploratory, concerned to clarify the areas and to formulate questions. The pilot work by contrast was more precise and based upon tasks to be used - in some form - in the final assessment.

The following modifications were made as a result of pilot work.

Identity Re-construction Tasks (1 and 2)

In the pilot work for this task, the child was required to do three things:

- a) define, describe what he saw on the card;
- b) re-structure the material on the card, using only that material;
- c) finally, he was asked to compare his own efforts against the model and to note any deviations, etc.

It was realised that these tasks did not adequately challenge the child, in that it was possible, sometimes, to carry out (b) by turning the building sideways-on, for instance, that is, answering the question, without really facing the matter of re-structuring. It seemed necessary to force the subject to face the problems involved in radical re-construction. Consequently the tasks were modified to include:

- a) (unequal) division of the building into two;
- b) a change of shape for the building.

In the second re-construction task (2), it was expected that young subjects might well have difficulty in understanding the question and further, find the task itself impossible to carry out at any level (the task involved re-structuring the leaf and the square). Consequently, a type of 'bridging task' was developed for the benefit of younger subjects. In this bridge-task, subjects were to be given an item for re-construction which would be presented initially in jig-saw form, and they were to have been asked to make as many re-constructions as they could think of. Then the subjects were to have been asked to draw some of their attempts. From this, they were to have moved to the main item - re-constructing without concrete props. However, surprisingly, it was found that even the youngest subjects were quite able to understand the logic of the task (as their attempts illustrate) though they were not always able to re-construct with accuracy. The bridge-task, used only in pilot work, was therefore dropped.

Symbolic Meaning and Re-classification Tasks

One item - Symbolic Meaning - was actually dropped from the battery of tasks as a result of pilot work. This item, inspired by some of Berko's work (1958), required the subject to supply meanings to nonsense words on the basis of symbolic cues or context, the purpose being to note ability, at different ages, to respond on the basis of these different criteria. However, it was found that the youngest subjects still had sufficient difficulty with reading to feel very 'unfree' with words. This difficulty was also found with the Re-classification Task, which was in fact retained but not for the youngest of subjects.

Conclusion

The pre-pilot work served to develop measures which were eventually used in the main part of the assessment. Pre-pilot work is also valuable in enabling the researcher to better understand and formulate the questions he is seeking to put. The subsequent pilot work resulted in some changes to proposed tasks and it provided the researcher with some experience of using the tasks in an assessment situation.

A major outcome of the pilot work was the generation of descriptive sub-categories used in scoring. These categories stemmed from a consideration of the responses of the pilot sample. A full explanation of these categories is given in the following section.

Chapter 5

CATEGORIES FOR THE ASSESSMENT OF TASKS

This section outlines the philosophy behind the assessment categories then proceeds to the presentation and explanation of the actual categories. Assessment methods are described and some concluding reference is made to potential refinement and improvement of categories - a point more fully discussed in the concluding chapter of this research.

Assessment is inseparable from the philosophy underpinning the research in question. What and how one assesses is related to what one thinks ought to be assessed. This research is not concerned with end products and their evaluation, but rather, with the abilities regarded as essential to creative transformations. It has been argued that creative transformations are based upon certain principles (re-definition, adjustment, etc). Interest is with the abilities, not simply in terms of existence or non-existence, but in terms of genesis and development.

In research which aims to be very exploratory, there was a desire to allow categories to emerge from observations rather than to construct them in advance. At the same time, some degree of order had to be imposed in advance, if only to give focus to the observations.

The major categories for assessment were generated before the tasks were carried out by the subjects, and are based upon the principles believed to underpin creative transformations. An example may help to clarify. The Elaboration Task embodies the principle of addition to an identity. It was easy to postulate in advance that a subject would either be able or unable to elaborate or would partly satisfy the task. Such a postulate led to further questions - such as, "what is adequate elaboration?" - what are the criteria, and more importantly, what are the characteristics which indicate various levels or stages of the ability? This last question led to the construction of a further set of sub-categories.

The sub-categories, which explain the major categories are really criteria for the "passing/failing" of a major category such as Elaboration (principle = addition). The sub-categories were not postulated in advance, but resulted from observations of pilot work as already mentioned in the previous section. A further example may help:

In the pilot work, concerned with the Elaboration Task, several points were noticed:

- a) before eight years of age subjects were sometimes unable to use the stimulus lines purposefully. Some subjects ignored them, drawing alongside;
- b) only about half of the eight year olds (and younger subjects) were able to re-define the stimulus lines. Re-definition, based on figure-ground reversal did not appear in the responses of subjects before nine or ten years at least;
- c) some subjects made obvious elaborations or additions to the stimulus lines. With age, greater subtlety appeared and the stimulus lines were more truly embedded in the final elaboration, determining much less the eventual outcome.

On the basis of such observations, sub-categories for assessment were drawn up. These categories are explained in detail in this section. Without doubt, there is a certain arbitrariness in their construction, but such a comment could be levelled at most modes of assessment. The focus could well be shifted and produce other aspects for assessment. This would be a matter of selection. There is, however, a further, distinct point - that of refinement.

In the introduction to the previous chapter the idea of "task-levels" was discussed. The search for such levels which essentially are landmarks of task-complexity and corresponding cognitive comprehension, must begin at the level of theory and of observations in the light of the theory. The sub-categories employed in this assessment, whilst in need of refinement through replication studies, are a first step towards the identification and labelling of such task-levels.

When explaining the tasks, the importance of avoiding context-specific tasks was mentioned. This same problem had to be encountered in

the construction and use of categories - and especially sub-categories. Getzels and Jackson (1962) touch (unconsciously?) upon the problem of the context-specific when they state:

"Creativity is a fairly specific type of cognitive ability reflected in performance on a series of paper and pencil tests."

The statement requires one to challenge the adequacy of the definition, and in turn the generality of the tasks and assessment procedures. If an explanation of creativity is to be adequate then it cannot be tied to certain modes and media. There are not different types of creativity and principles of a general nature must be found for its explanation and assessment. Context-specific types of assessment tend to throw up dichotomies such as verbal and non-verbal creativity (Torrance and Gowan, 1963).

This consideration led to an examination of the principles and the criteria for sub-categories. The principles (adjustment, addition, etc), it is believed, can be applied to all media. With regard to the sub-categories, it may be helpful to make reference again, by way of example, to the Elaboration Task (principle of addition).

The sub-categories generated on the basis of the type of observation already described were:

- a) use of stimulus lines;
- b) re-definition (including re-definition based on figure-ground reversal);
- c) deliberation;
- d) embeddedness.

It will be seen from the detailed consideration of these sub-categories on the following pages that such sub-categories are not tied to particular

Getzels, J. and Jackson, P. (1962) Creativity and Intelligence: Explorations with Gifted Children. P.16.

Torrance, P. and Gowan, (1963) "The reliability of the Minnesota tests of creative thinking", Res. Memorandum, Bur. Ed. Res. 4.

media or events. This is essential in a search for general explanatory principles and a comprehensive theory of creativity. As groundwork for the establishment of "task-levels", these sub-categories aim to be statements about attainment points in processes of transformation (each of which is described by a major principle - e.g. Elaboration). They are not descriptions of levels of transformations as tied to specific tasks.

CATEGORIES AND ASSESSMENT

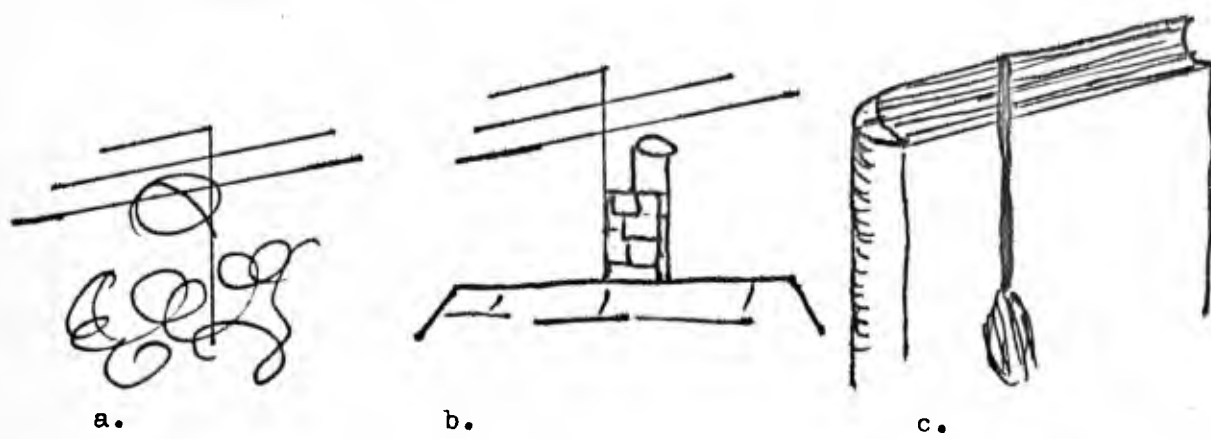
Elaboration Task

There were four items in this task, each item was presented twice.

a) Use of stimulus lines

It was noticed that many of the younger subjects found it difficult to integrate the stimulus lines into their drawings, tending rather to ignore such lines or to draw alongside them. Use of stimulus material is regarded as essential. Whilst it is held that the use of stimulus material in itself cannot necessarily lead to outcomes deemed 'creative', all creative outcomes are necessarily dependent on this ability.

"Use of stimulus lines" was regarded in all or nothing terms. Pilot work revealed that no subject 'partially' integrated the stimulus lines, though there was variation in terms of subtlety of integration (a further category). Therefore, the following would hold in the assessment of this category:



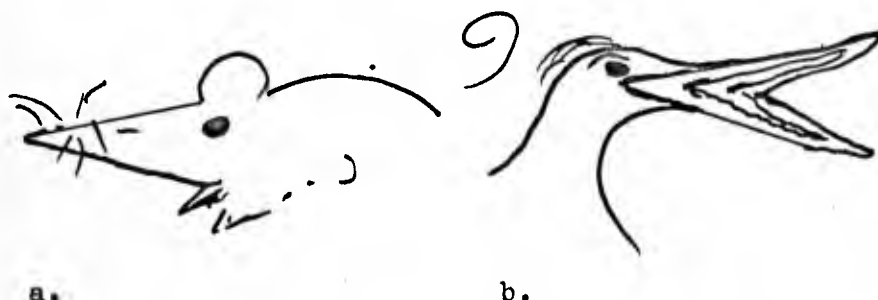
- a) is clearly not integrated, and it is an instance of an 'aimless' type of elaboration;
- b) uses the stimulus lines in a way that forms an obvious relationship between the lines and the outcome;
- c) integrates the lines with greater subtlety.

However, both (b) and (c) would be regarded as having "used" the stimulus lines. A subject who exhibited this ability on at least 6/8 responses would be regarded as having satisfied that aspect of the main item.

b) Re-definition

This relates to the subject's ability to re-apprehend and so re-define a structure. In terms of assessment this was regarded as enabling the subject to produce a different drawing for each of the two trials. Therefore, a subject who produced two 'different' butterflies would not score on a particular item, whereas a subject who produced a 'butterfly' and a 'wine glass', would score on this particular aspect of the item. Where a subject showed the ability to re-define three out of four stimulus lines, that subject was regarded as having satisfied that aspect of the main item.

(Figure-ground re-definition) Some re-definition took place on the basis of figure-ground transformations - though very few of the younger subjects illustrated this type of re-definition. They tended rather to produce two different solutions whilst still interpreting the stimulus lines from the same base-line, or from the same figure-ground standpoint. Others showed the following ability:



In the above responses, the "V" shape stimulus line, is used both as 'figure' and as 'ground'. Figure-ground re-definition, is essentially, therefore, an explanation of the nature of the definition and is not in itself a major sub-category, but an aspect of re-definition.

c) Deliberation

It is argued that recognition of potential involves the ability to define, in some way, what is recognised. Children, therefore, who drew without a purpose, who could not name their drawing before completion of elaboration, were regarded as not having satisfied this aspect of the item.

d) "Embeddedness"

In elaborating, some subjects showed an ability to forge less structurally obvious relationships between the lines and the outcomes. This is not the same thing as statistical infrequency, for it is not a matter of the number of responses or their infrequency, but a realisation of structural implications on the part of the subject. "Embeddedness" requires that the stimulus lines are truly integrated into the elaboration, and do not in themselves determine the major part of the elaboration. Embeddedness was expected to be related to figure-ground transformations. The following examples attempt to illustrate:



a)



b)

In (a), the "V" shaped stimulus line determines, to a large degree, the final form and outcome. In (b) where the same stimulus line is elaborated upon, the final outcome is less determined by the "V" shaped stimulus line.

A subject was required to illustrate this ability on any 4/8 responses. There is no firm hierarchy of relationship of sub-categories, though the latter category (d) is seen as being dependent upon sub-categories (a), (b) and (c). As a sub-category, it is regarded as qualifying sub-category (b) - re-definition - for embeddedness is a quality of re-definition.

In order to satisfy the Elaboration Task, subjects were required to possess abilities needed for sub-categories (a), (b), (c) and (d).

Free Problem Solving Task

1. The Matchstick Problem

Observations during the pilot work quickly clarified the fact that children who were able to grasp the notion of a basic paradigm and then re-organise this paradigm to arrive at as many different variations of it as possible, were the most likely to produce a high number of solutions. Such systematic examination of a structure is very characteristic of formal operational thinking. Such an approach is exemplified in the classic experimental situation of Piaget and Inhelder's which requires the subject to produce a given liquid colour from a combination of coloured liquids (Piaget and Inhelder, 1958), and regarded as essential to mature creative explorations if a subject is to comprehend the notion of possibilities. A haphazard like examination of a structure, or structures, as instanced by many of the younger subjects in this sample seems to be accompanied by a lack of realisation of the implications of one's own activities. Two sub-categories were developed on the basis of these observations:

a) Paradigmatic variations

This kind of variation required that the subject offer a solution or solutions, and at some point during the task he explore the possibilities

of that same solution by varying it, e.g:



etc.

(i) variation of a paradigm

as opposed to:



etc.

(ii) non systematic explorations

This systematic type of behaviour was easily visible during task performance. Its opposite was illustrated by haphazard searchings, refusals to return to earlier efforts on the basis that: "I've done that one already", inability to remember what had been done, and above all, a small number of solutions. A subject who provided a solution and explored that same solution to the extent of at least two further variations (three in all) was regarded as exhibiting this organised type of exploration.

To satisfy this aspect of the item, at least half of his solutions had to be obtained in this way.

b) Fluency

In itself, fluency is not regarded as an index of creative potential. There are too many complex motivational and orientational problems in an area such as creativity to treat fluency seriously. However, where fluency might be related to some structural ability, it is believed that it is of importance. Here, fluency is regarded as an outcome of paradigmatic variation. The discovery and use of a paradigm must increase the total output. Any subject offering at least five correct solutions, and satisfying category (a) here, was regarded as having satisfied this aspect of the

item. The number 5 was chosen quite arbitrarily after initial observations of pilot subjects. 5 seemed to be a reasonable average minimum.



= one solution, because the second is a repetition (in reverse) of the first.



= two solutions, because the second is a genuine variation.

Subjects were required to satisfy sub-categories (a) and (b), to satisfy the item itself.

2. The Bottle Top Problem

On considering pilot responses to this task, it was evident that a critical factor was not simply the generation of a new solution but an adequate grasp of the structure of that solution, and of the structural implications. Further, the solution had to relate to the structure of the bottle top in question. Responses were considered in terms of degrees of organisation of response, not simply in terms of verbal organisation, but rather conceptual organisation. The following sub-categories were developed:

a) Systematic and organised

Here the response was related to the task in hand. The subject offered an organised description of the solution, showed an understanding of the relationships of the component parts and a grasp of implication, and had a clear and steady concept of his own solution.

b) Partially systematic

There was evidence of some organisation, but there was a lack of implication and parts did not always relate well. When questioned about their suggestions, such subjects showed that they were not always aware of possible implications and outcomes, and further, that they lacked

a clear and steady concept of their own solution.

c) Non-systematic

Such responses were often made up of bizarre responses, isolated statements showing a complete lack of relationship to the problem in hand.

Examples of responses falling into each of the above sub-categories are given in the section dealing with interpretation.

In order to satisfy this item subjects were required to show a minimum of organisation in their solutions and to fall, therefore, into either sub-category (a) or (b). Subjects were required to satisfy both items in this Task.

Identity Recognition Task

There were three items in this Task - each item presented twice. This task differs from the Elaboration Task, in that here the subject is required to structure and define existing stimulus lines, as opposed to developing or elaborating upon basic stimulus lines. The following sub-categories were employed in assessment:

a) Use of stimulus lines

Subjects were required to structure identities from the lines provided. They were allowed to add only minor details - e.g. an eye or a tail where an animal had been depicted. As with the Elaboration Task it was noticed, in pilot observations, that younger subjects had great difficulty in using the stimulus lines and tended rather to draw alongside them. Subjects who used the stimulus lines on 4 out of 6 of the responses were regarded as having satisfied this aspect of the main item.

b) Purposeful drawing

Again as in the case of the Elaboration Task, subjects were required to state/name the outcome before completion. Un-named shapes were not accepted. When a subject drew without any real purpose, then tried to find a label after the drawing, this too was discounted. Subjects had to satisfy this criteria on four out of six of the responses. Clearly sub-categories (a) and (b) are closely related.

c) Re-definition

Essentially, this requires that the subject be capable of re-apprehending the stimulus lines. This would not include instances where the subject would pick out very small areas from the lines, thus using different areas of the stimulus lines for each trial, and as such therefore not truly re-defining. Instead, a subject would re-use, in a different way, stimulus lines, or parts of those lines, already used in the first trial of the item.

d) Constructive integration of at least $\frac{1}{3}$ of the stimulus lines

With age, it was observed in pilot responses, that subjects were capable of integrating increased amounts of the stimulus lines into their responses. Subjects integrating at least one-third of the stimulus lines were in a better position to truly construct an identity from the stimulus lines provided, as opposed to those who picked out a small shape.

To satisfy this item - Identity Recognition - subjects were required to fulfil the requirements of sub-categories (a), (b), (c) and (d).

Identity Re-construction (1)

This item has four parts each of which is assessed independently. To satisfy the task as a whole, the subject has to meet the requirements of all four parts.

Item 1: Definition/Description

Basically, this task is concerned with the ability to comprehend a given structure - essential if re-structuring of some type is to come about. Three sub-categories were drawn up for the assessment of this aspect:

a) An organised definition with correct information

The subject was required to give a correct and organised description of the information (a block of flats) on the card. This required that the subject organise the structure - relate the parts and describe in objective terms without distorting the information through assimilation.

b) Towards an organised description with correct information

Whilst lacking the precision and organisation of sub-category (a), information in this category was mainly correct and objective, and there was some understanding of the relationship of the parts to the whole.

c) Ego-centric and unrelated information

Subjects in this sub-category has no organised concept of the block of flats, but seemed to conceive of it as un-related parts. Further, their information was inaccurate and distorted by assimilation. Information was often invented.

To satisfy this part of the item, subjects had to provide definitions which fell into sub-categories (a) or (b) - i.e. a minimum of organisation was required.

Item 2: "Change the building in some way"

Essentially, this task requires the subject to grasp the structural implications of the identity in question, so that he can re-construct that identity in some way. Two sub-categories were developed:

a) Re-structures correctly on a non-unit basis

Here the subject retains the rectangular shape of the building and simply changes the position of the windows. However, a change is effected.

b) Re-structures on a unit basis

This time, the subject does not retain the rectangular shape but defines the building in terms of the individual units which comprise it - thus changing the outline of the building. Other changes are sometimes included too - e.g. change in order of windows.

In terms of assessment of this task, satisfaction of either of the above sub-categories is regarded as 'passing' this aspect of the item. Further observations were made - observations concerned with details such as adding or leaving out material, holding a poor concept of a building - i.e. concentrating all the bricks in one corner. However, such information is not regarded as forming a further sub-category, but rather explains the kinds of errors preventing a subject from falling into either sub-category (a) or sub-category (b).

Item 3: Unequal Division

This task required the subject to come to terms more thoroughly with the structural aspects of the problem, for here, the subject was required, to some extent, to move away from the rectangular outline. The following sub-category was drawn up:

Correct division of structure

This required that the subject divided correctly, both the major units (squares) and the windows within the structure. Some subjects had difficulty in allocating the correct number of windows even though they managed to divide the actual structure. Subjects were obliged to divide the building unequally, a requirement which forced them to consider the

building more in terms of individual units. Some subjects just managed to avoid this requirement by dividing the building equally, removing the top layer from one half and adding it to the other half. Satisfaction of this sub-category was essential.

Item 4: Change of Shape

This task required a change of shape in the building which required that the subject have a very adequate grasp of the structure of the identity and of the implications of changes to that structure. To assess performance, the following sub-category was constructed:

Changes shape correctly relating it to units

By which was meant that the subject was aware of the individual units (20) and took their size and shape into account. Subjects unable to do this distorted the building to any shape which suited their interest.

What Would Happen If Task

Basically, the subject was required to construct an imaginary system of relations. At a more concrete level, the Bottle Top problem had required the subject to relate identities to solve a problem. Now the subject is required to relate identities without concrete props of any kind. A grasp of implications of relating is required.

The following sub-categories were established:

a) Constructs a system of well related ideas

Subjects in this category showed a grasp of relations and of the implications of relating. They were able to see that a change in one area of a system would have implications for another area, and had a clear and steady concept of their proposal.

b) Towards a system of well related ideas

A matter of degree. Subjects had well organised ideas for the most part, however, there were still traces of disorganised thinking and instances of lack of implication, and further, they presented "related ideas" as opposed to a system of ideas". Their concept of the solution was less clear and steady.

c) Unrelated, ego-centric ideas

Such responses consisted mainly of comments - usually brief - on unrelated aspects. They were very much tied to immediate experience and to the world of the child and showed no grasp of relations or of implications.

To satisfy this item subjects were required to supply information of the sub-category (a) or (b) type on both items in this task.

Re-classification

After consideration of the pilot work it was decided that the responses of the youngest group could not be included due to their reading difficulties. This was further confirmed by the research itself - and as a consequence, the results of this age group were not included.

Essentially, in this task, subjects were required to form associations employing different, self-chosen criteria. Sub-categories for this assessment were developed from two sources of experience: (1) an earlier project on ways of signifying words; (2) the pilot work. The following sub-categories were constructed:

a) Objective criteria

When a subject associated words on the basis of common criteria - e.g. colour classification.

b) Shape-sound criteria

When subjects associated words because "they sound the same" or "they have the same letters in them, they look the same."

c) Association

When neither of the above categories was employed, but instead the subject formed relationships on the basis of associations - personal or common, e.g.

shadow - bark - shell - paper "because they are all dead things
taken from a living thing"


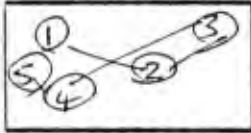
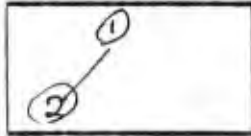
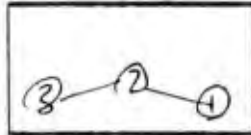
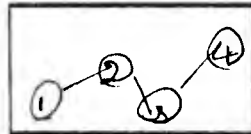
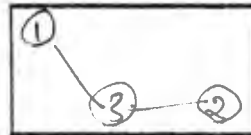
Subjects were required to satisfy this latter sub-category.

Number and size of groupings

In any one grouping a subject was required to have a minimum of three words associated. It was felt that if two words were allowed (counted) subjects would be more likely to 'pair' words according to common usage (e.g. red - anger) than to seriously search for associational criteria. Beyond this, no extra points were given (i.e. for groupings larger than three) as this might then become a 'fluency' matter, and less a matter of establishing ability to make associations on new criteria.

For the same reasons, subjects were required to produce a minimum of five such groupings. This was because in order to make the task possible, at least one fairly obvious grouping was included. It was thought that by asking a minimum of five associative groupings, a genuine search for criteria would have been essential on at least four of the groupings. Subjects were encouraged to go on trying to form groupings until it was obvious that they could not continue.

The following table illustrates the method of scoring for this Re-classification Task.

		<u>Criteria</u>	<u>Size of Grouping</u>	<u>Score</u>
Trial 1		Association	5	1
2		Association	5	1
3		Objective	2	0
4		Association	3	1
5		Association	4	1
6		Association	3	1
		TOTAL		<u>5</u>

This subject would satisfy the Re-classification Task with a minimum score of five accepted groupings.

A subject was able to employ a word more than once, given that this was done in a new association, based on new criteria. The cards on the left illustrate the way in which the words were ringed by the examiner, and the sequence in which they were ordered.

Identity Re-construction (2)

Task 1: Definition

See Re-construction (1) for sub-categories.

Task 2: Re-construction

This task requires somewhat different sub-categories from earlier re-construction tasks largely because it does not require a convergent type answer. The subject is required to re-structure given identities as he wishes. He is required to respect the constraints of the materials. The following sub-categories were constructed:

a) Correct (figural) definition

This required that the subject, when re-constructing, use the correct number of pieces - i.e. did not repeat or missout lines, and further, that he maintain reasonable size-relations.

b) Constructive use

Required that the subject show an ability to reconstruct the lines to form a well organised shape or form, as opposed to a fragmented series of lines.

Subjects were required to satisfy both sub-categories and the definition sub-category to be regarded as having 'passed' this item.

ASSESSMENT PROCEDURES

No assessment of responses was made until all data had been collected. A two-fold assessment was made:

- a) an assessment in pass/fail terms which stated that a subject did or did not possess a particular ability regarded as essential to a given type of creative re-structuring, e.g. Elaboration.

b) an assessment based on the sub-categories which highlighted the particular aspects of the problems which a subject or subjects found difficult or impossible.

This two-fold method was decided upon because there was a desire to be able to make some overall statements about ability in given areas - but it had to be the type of statement which would lend itself to qualitative comment and developmental analysis - possibly stage analysis. It was believed that this two-fold assessment method could achieve this.

Assessment and the use of a panel

The assessment of abilities in transition can posit problems. Miller and Heldmeyer (1975) have noted the problems of assessment of such abilities. Piaget and Fraisse (1970) encountered similar problems. Examining the development of intellectual operations by means of a study of conservation, Piaget and Inhelder first established context-specific categories (of weight, substance, etc) and then proceeded to classify responses according to the existence or non-existence of the ability, adding a further category called "transitional", for which they have criteria. The problems of course lie in the application of criteria!

It is believed that the assessment of abilities in transition could be affected by researcher bias especially when criteria deciding various degrees of establishment of an ability are, in themselves, in a state of development and refinement.

Because of the problem of application of criteria to abilities in transition, a panel of judges was employed. It should be stressed that

Miller, P. and Heldmeyer, K. (1975) "Perceptual information in conservation: effects of screening", Ch. Devt. 46, pp 588-92.

Piaget, J. and Fraisse, P. (1970) Experimental Psychology: its scope and method, VII.

this panel was employed as a form of reliability check only. Assessment in this research is not arbitrary in that agreement, in some degree, by a panel or group is regarded as constituting 'ability'; a subject is either able to adjust a structure or he is not. However, it can be difficult to detect and to label emergent abilities. Consequently, a panel was thought to be of importance in an anticipated few marginal instances where transitional abilities might posit such problems.

The panel consisted of four final year psychology degree students and myself. All the students had at least a working knowledge of Piaget's theory of knowledge and an explanation on the purpose and aims of the research was given. The criteria explained on the previous pages were presented, verbally and in written form, and there was a trial run using some of the pilot work. The main purpose was to prevent researcher bias. It was decided in advance that an agreement of 4/5 at least would be required before an ability could be placed in any one class. The raters worked together, as a group, task by task. Each rater ticked their response on a score sheet. When this had been done responses were shared and the conclusion achieved. Working task by task, prevented the raters from building up a profile on any one child and so anticipating ability from one task to another. It was found, in fact, that agreement by the raters was so consistently high (over 95% over all tasks) that the use of such a panel could have been avoided. Certainly one was in no greater need of this kind of reliability check than Piaget and Fraisse (1970, *ibid*)!

Categories not assessed by the panel

The following sub-categories could not be assessed by the panel. They had, for obvious reasons, to be judged by the researcher at the time of the assessment. They were not marginal categories, however.

<u>Task</u>	<u>Sub-category</u>
Elaboration	Deliberation
Identity Recognition	Purposeful drawing

Sub-categories and the notion of stage

The notion of stage is assumed in this explanation of creativity though it is not possible to come to any firm conclusions at an empirical level about stages of creativity. However, possibilities for future, more refined conclusions lie within the sub-categories of assessment which are concerned with the qualitative and transitional dimensions of the responses.

An attempt to consider stage immediately raises numerous problems - some stemming from the concept - others from the difficulties of classifying reality. Beilin (1971) has referred to the fact that Piaget's examination of conservation for instance, is most often very context-specific. This is quite acceptable for he is discussing the development of an ability. One problem of categorisation is that of deciding the width of the categories. The decision must be made, of course, in relation to the purpose of the activity. An aim here has been to strive for general as opposed to context-specific categories in an attempt to work towards general, explanatory stage-criteria. For this reason, detailed criteria explaining the development of each major principle have not been developed. Instead, some attempt to classify responses according to degrees of organisation has been made. There are, however, variations - essential in initial exploratory work - for early systematisation brings its own dangers. The implications of the sub-categories for a more refined stage-analysis of creativity will be discussed at a later stage in this research.

Chapter 6

A CONSIDERATION OF ~~THE~~ FINDINGS (1)

This chapter is essentially descriptive, reporting the findings, including relevant illustrations of a selection of responses.

The following chapter examines the findings in relation to the theory underpinning the research and makes further interpretations in the light of the statistical analysis.

INTRODUCTION

It is felt that it would be helpful to have, at this point, a table of the major categories in which the findings are to be presented, to serve largely as a reminder. Sub-categories regarded as essential to satisfying the task are marked *. On the following pages, findings are presented in graph form for the tasks as a whole, and for the sub-categories of the tasks. A profile of each subject's performance will be found in Appendix III.

Task 1: Elaboration (Principle = Addition)

Sub-categories: use of stimulus lines *
 re-definition *
 re-definition based on figure-ground reversal
 deliberation *
 embeddedness *

A subject satisfying all sub-categories marked * was regarded as having "passed" the item. Figure-ground reversals, which increased with age, led to some interesting elaborations but were not regarded as fundamental to the task.

Task 2: Free Problem Solving (Principle = Re-organisation)

Sub-categories: paradigmatic variations *
 (task a) fluency *
 (task b) organised response
 partly organised response *

In task b of this main task, a minimum of organisation was required in the response. Either of the sub-categories therefore could satisfy the requirements of the task.

Task 3: Identity Recognition (Principles = Apprehension and Re-definition)

- Sub-categories: use of stimulus lines *
- purposeful drawing *
- constructive use of at least $\frac{1}{3}$ of stimulus lines *
- re-definition of stimulus lines *

Task 4: Identity Re-construction (1) (Principles = Definition, Re-organisation and Division)

- Sub-categories: an organised response
- a partly organised response *
- correct re-construction on unit basis
- correct re-construction on non-unit basis *
- correct division of structure *
- correct change of shape of structure *

Categories marked * indicate the minimum amount of understanding of the task required to "pass" the whole task.

Task 5: What Would Happen If Task (Principle = Re-organisation)

- Sub-categories: an organised response
- a partly organised response *

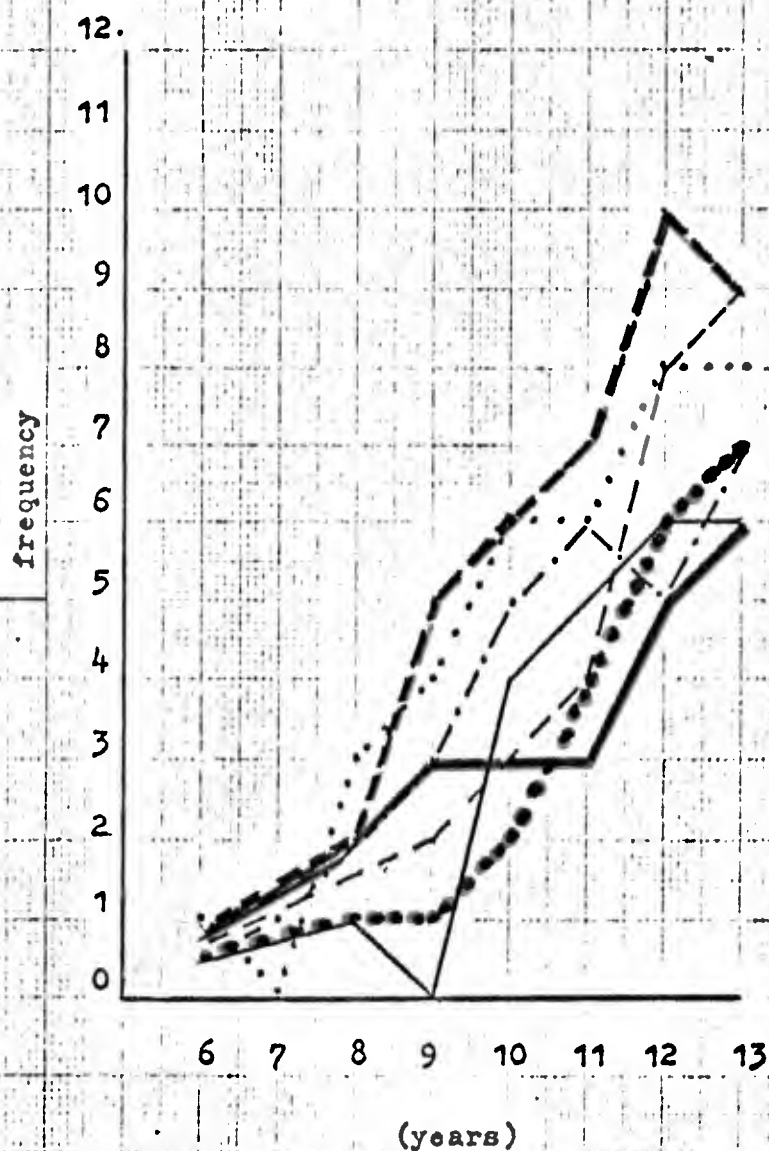
Task 6: Re-classification (Principle = Re-relating)

- Sub-categories: objective criteria
- shape/sound criteria
- association *
- fluency *

Task 7: Re-construction (2) (Principles = Definition and Re-organisation)

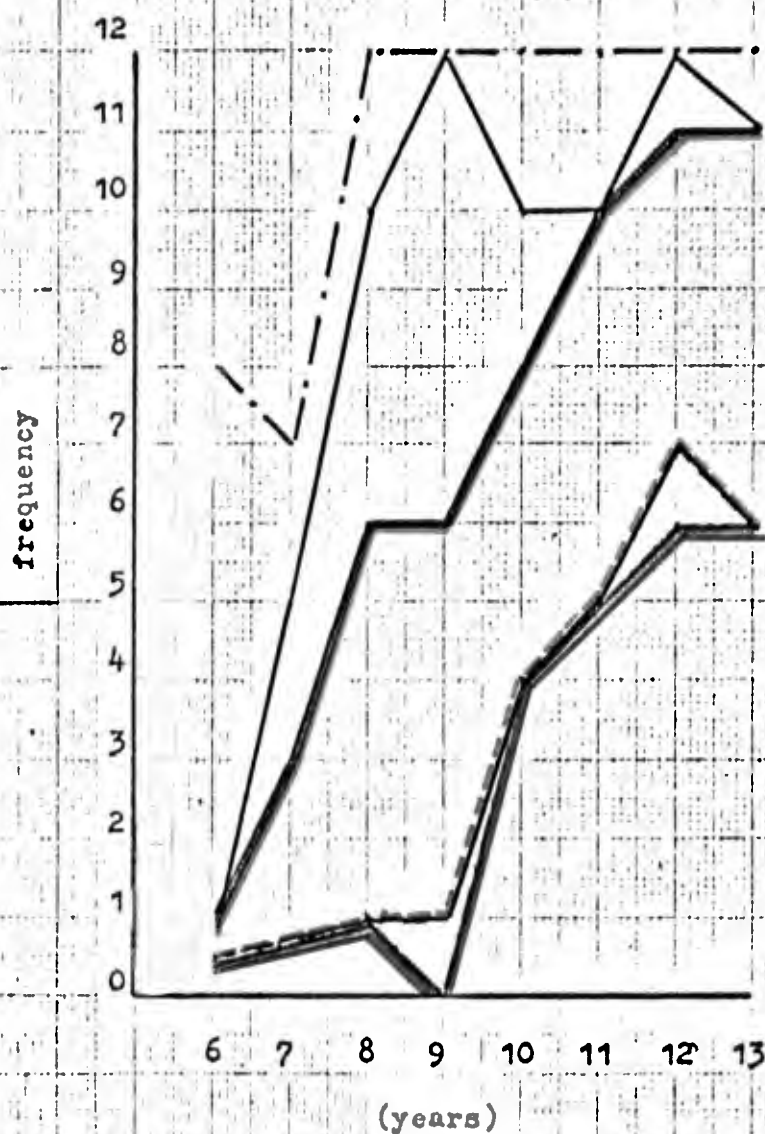
- Sub-categories: an organised response
- a partly organised response *
- correct figural definition *
- constructive use of stimulus lines *

PERFORMANCE ON ALL TASKS BY AGE.



- = The Elaboration Task.
- - - - - = Free Problem Solving Task
- = Identity Recognition Task.
- = Identity Re-Construction Task (1)
- . - . - = What Would Happen If Task.
- ● ● ● ● = Re-classification Task.
- . - . - = Identity Re-Construction Task (2).

A BREAKDOWN OF THE ELABORATION TASK BY AGE.



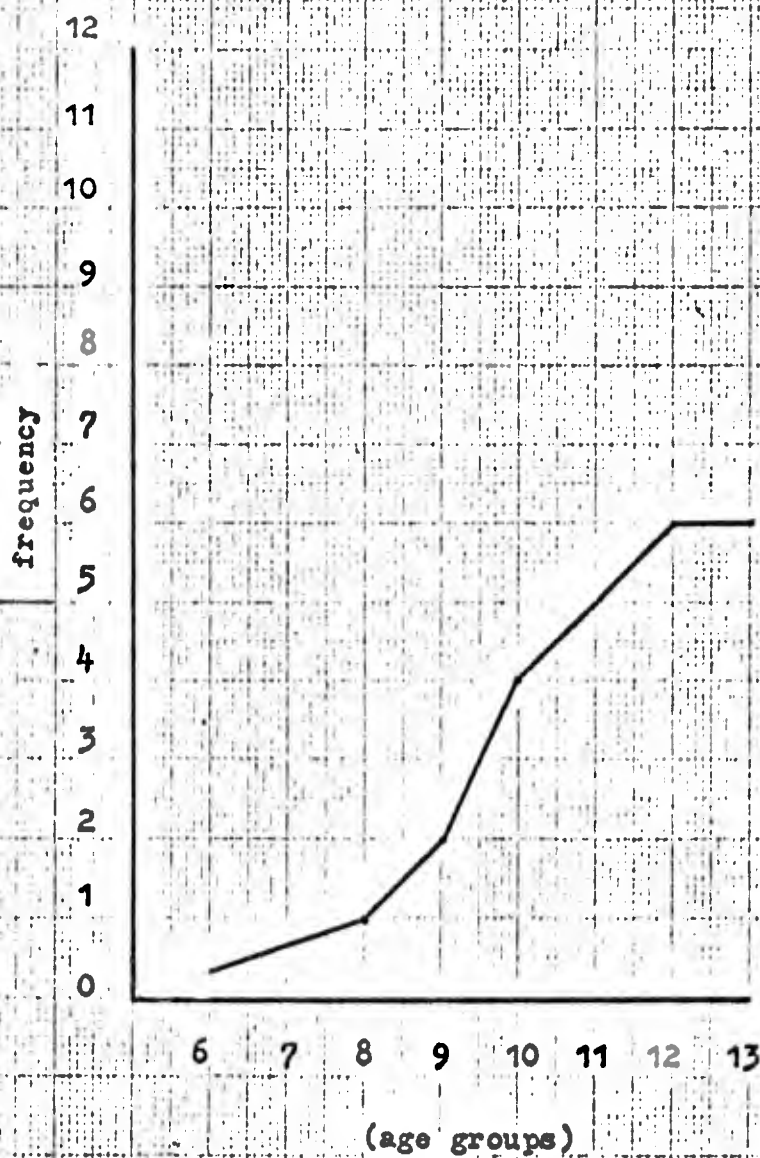
--- = use of the stimulus lines.

— = re-definition of the stimulus lines

... = re-definition based on figure-ground

— = purposeful drawing (i.e. could name outcomes)

— = "embeddedness" of stimulus lines.

THE ELABORATION TASK BY AGE.

THE ELABORATION TASK

A main characteristic of the younger age groups (6 and 7 years) was that most of them began to draw immediately without thoroughly assessing the stimulus lines. Only 6/24 subjects knew what their drawings would be in advance. The majority simply began to draw, adding, considering, attempting to fit their response into some category. Most overcame this latter difficulty by drawing patterns of shapes. Generally, there was a very direct and obvious relationship between the stimulus lines and the elaboration, the most frequent elaborations for Item 1, for instance, being - church towers, bird's beaks or hats. Older subjects, by contrast, were capable of more remote relationships between stimulus lines and the elaboration, further, there was a greater variety of actual elaborations. Only 15/24 subjects in the 6 and 7 year group were really able to integrate the stimulus lines into their elaborations. The others either drew alongside the lines or over them, entirely ignoring their direction. There was a very real lack of detail in the elaborations and no child from this group was able to produce figure-ground variations.

Four subjects in this 6-7 year old group who produced more detailed drawings, accompanied the elaborations with a story and the elaborations was developed in line with the tale. Such elaborations were interesting examples of phantasy versus imaginative potential. As drawings, they were of interest but there was no reality adjusted attempt to build on the stimulus, and the final elaborations were quite different in quality from those of older subjects who were well able to incorporate these same lines into scenes or objects. These younger subjects adjusted the stimulus lines to fit their train of thought, whereas older subjects made a more obvious attempt to adjust their efforts to the stimulus lines.

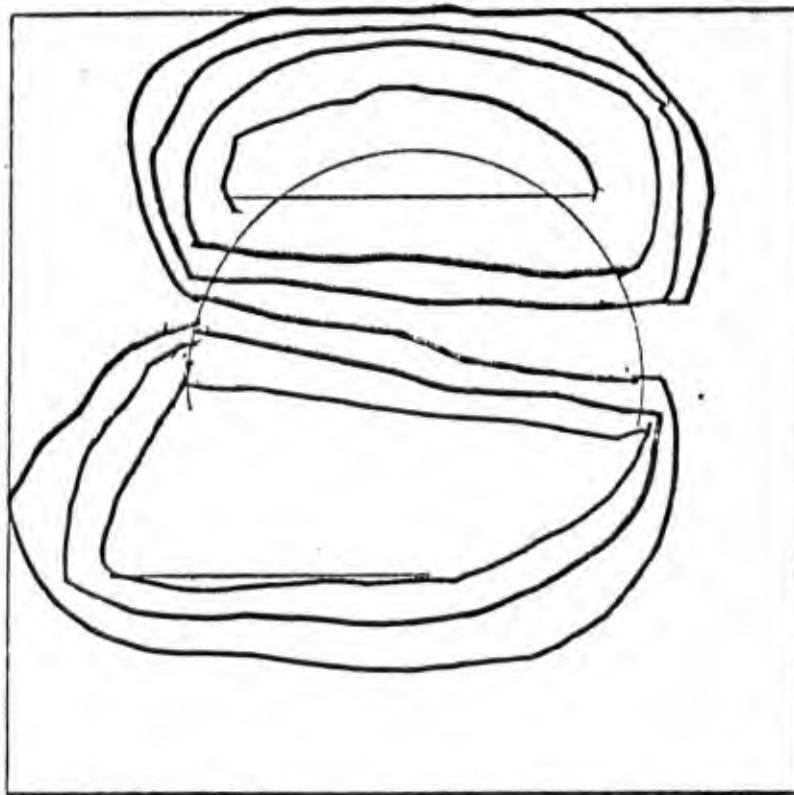
PLATE 13

boy.6:7.

Children in the 6 and 7 year old groups did not always use the stimulus lines as illustrated above.

The boy here spent about 2 minutes looking at the lines from different angles, and then drew calling the shape a "big hairy thing". When asked about the stimulus lines he explained that they were the "monster's stick" then said- "no, they are not really in the picture".

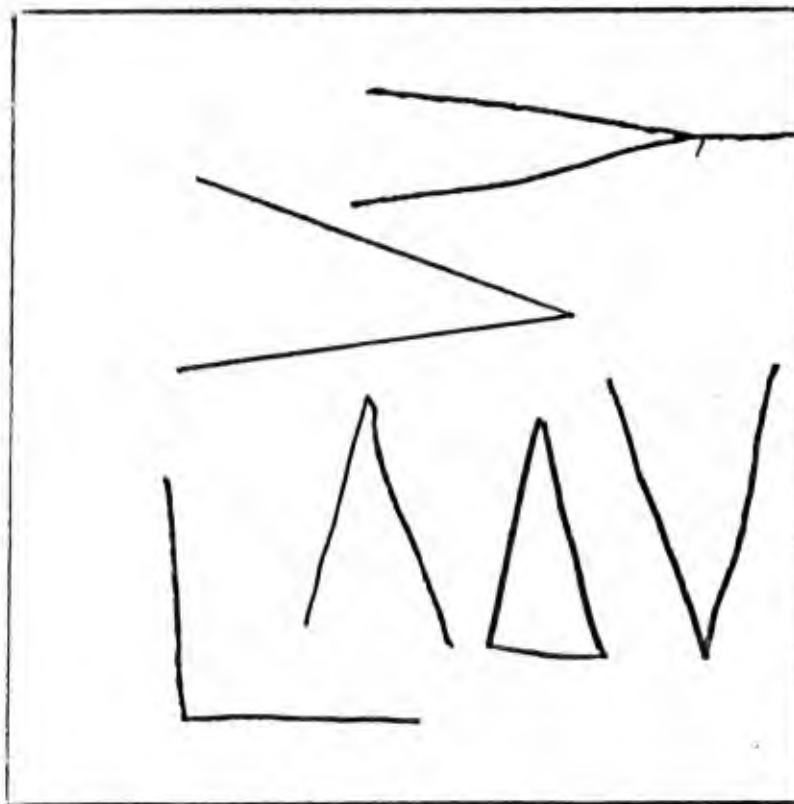
From: Elaboration Task (item 3).

PLATE 14

girl.6:7.

Ss. in the 6,7, and 8 year old age groups often drew patterns when they could not use the stimulus lines in another way. The 'patterns' are quite different in type from the "abstract patterns" produced by some of the older subjects who not only drew with design and deliberation but were also able to name their pattern as representing some idea or theme.

From the Elaboration Task. (Item 4.)

PLATE 15

boy.9:3.

This kind of response was more often found in the efforts of the 6 and 7 year old group and was not found in the age groups above this one.

Some younger Ss. seemed to find it very difficult to use or integrate the stimulus lines, and would instead, sometimes draw alongside them or respond in the above manner.

From the Elaboration Task. (Item 1.)

With the 3 and 9 year old subjects, there was a marked increase in ability to integrate the stimulus lines into the elaborations (24/24 as opposed to 15/24 in previous group). There was still a very direct relationship between the stimulus lines and the elaborations and there was often a lack of detail in the drawings. However, more subjects in this group elaborated after reflection and an increased number could in fact name the outcome before drawing; in other words, the drawing was not defined as it went along. (22/24 as opposed to 6/24 in previous age group). In this group there was the beginnings of the use of figure-ground variations (2/24 as opposed to 0/24 previously).

The following age group - 10 and 11 year olds - showed yet a further increase in ability in most of the areas discussed. Stimulus lines were well integrated, drawings were detailed and almost all the subjects could name the outcome of the elaboration before embarking upon it (20/24). The number of responses showing remote relationships between the stimulus lines and elaborations was 9/24, as opposed to 1/24 for the previous age group.

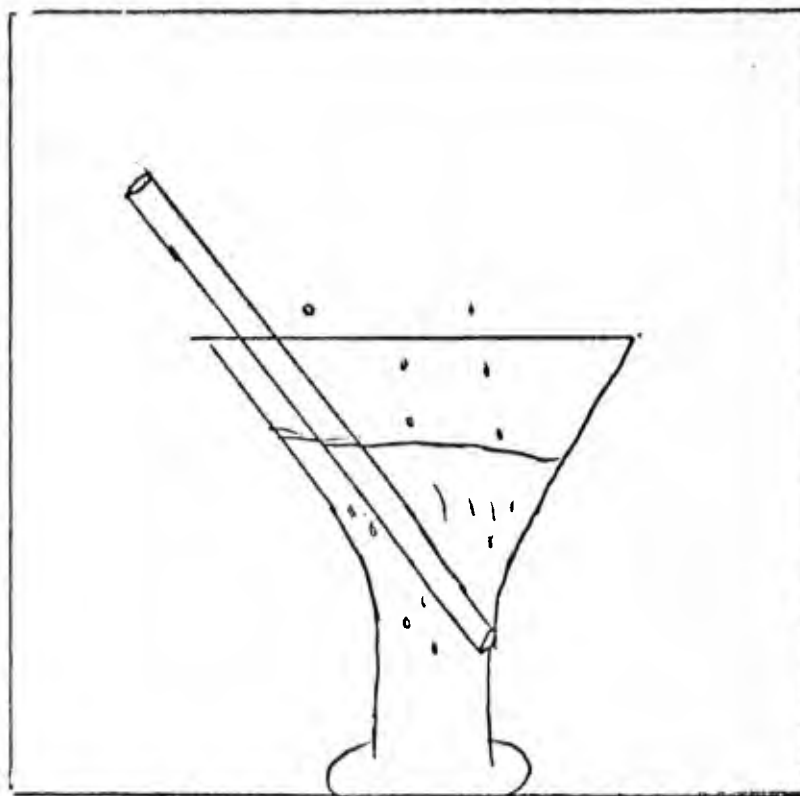
Amongst the oldest age group (12 and 13 years) there was a further general rise in these abilities. All subjects integrated stimulus lines, produced detailed drawings, which they could name in advance and 22/24 used the stimulus lines from different angles including figure-ground variations (13/24). It was anticipated that most of the subjects in this older age group would be capable of "embeddedness", i.e. of less direct relationships between the stimulus lines and the elaborations, but in fact only 12/24 managed this. 5 subjects in this age group included abstract type patterns. These were quite different in quality from the "patterns" offered by younger subjects, for they were named in advance and the theme or topic depicted was apparent.

PLATE 16

boy. 11:6.

This subject's second attempt on this item shows the "V" shape used as 'figure' instead of as 'ground' as used in this drawing. Most Ss. in this age group were able to offer figure-ground variations in their responses.

From the Elaboration Task (item 1.)

PLATE 17

girl. 10:7.

Only four children in this age group showed themselves capable of perceiving "remote relationships" between the stimulus lines and the elaborated object.

In this particular task the most popular response was a television ariel. The above response - a glass and straw - uses the stimulus lines from a very unusual angle.

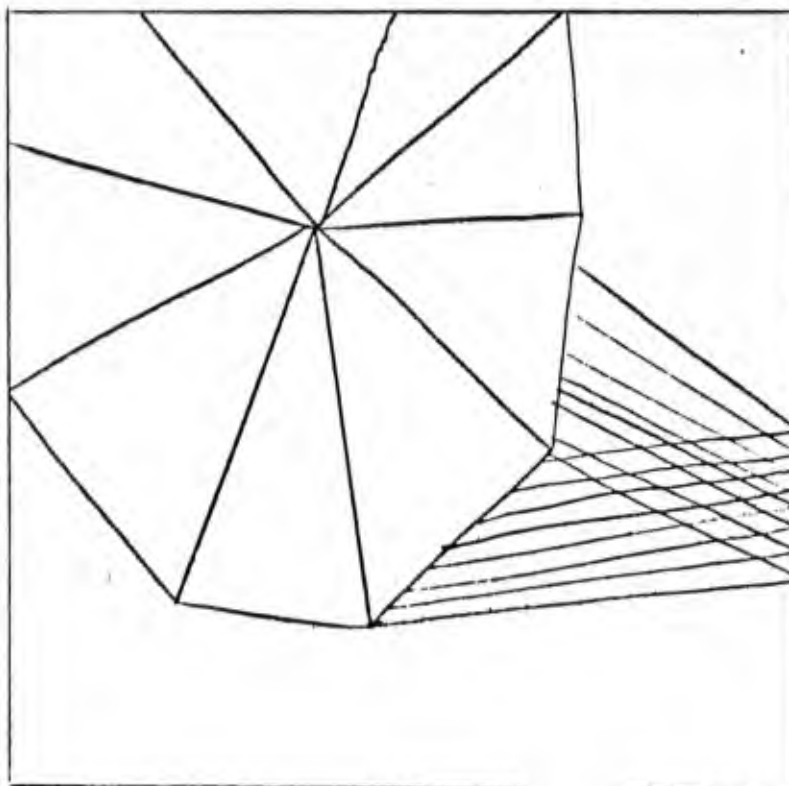
From the Elaboration Task (Item 3)

PLATE 18

girl. 12:10.

The subjects in this age group were capable of more remote relationships between the stimulus lines and the actual elaboration. By contrast for instance, younger Ss. especially in the 7yrs. - 10 yrs group. tended to elaborate in obvious ways turning this "V" shaped line into church towers or bird's beaks. The use of the same "V" shape here is a much less obvious one.

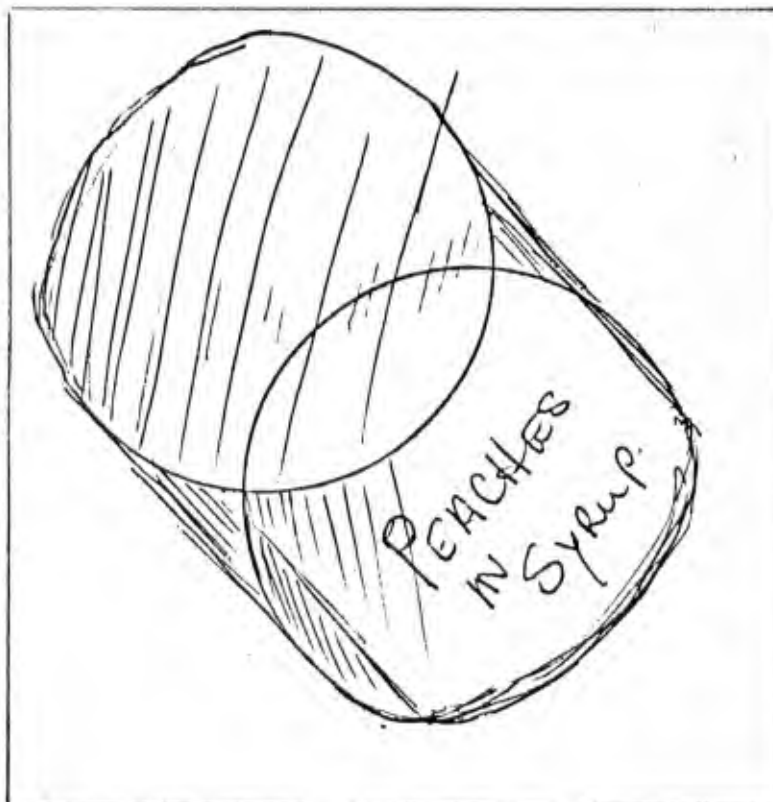
From the Elaboration Task. (first item)

PLATE 19

girl. 13:6.

A small number of subjects asked if they could elaborate in an abstract way. The topic was named in advance (the above was called: Umbrellas). Such attempts are quite distinct in kind from the "patterns" produced by younger Ss. Such patterns were usually offered because they were unable to elaborate in other ways. Further patterns were not named and were defined as the drawing was carried out.

Elaboration Task. (first item)

PLATE 20

girl. 13.8.

Subjects in this age group showed an ability to deal with the stimulus lines from unusual angles. Further, they tended generally, to approach the stimulus lines from a different angle (or figure v. ground) on each presentation of the same lines.

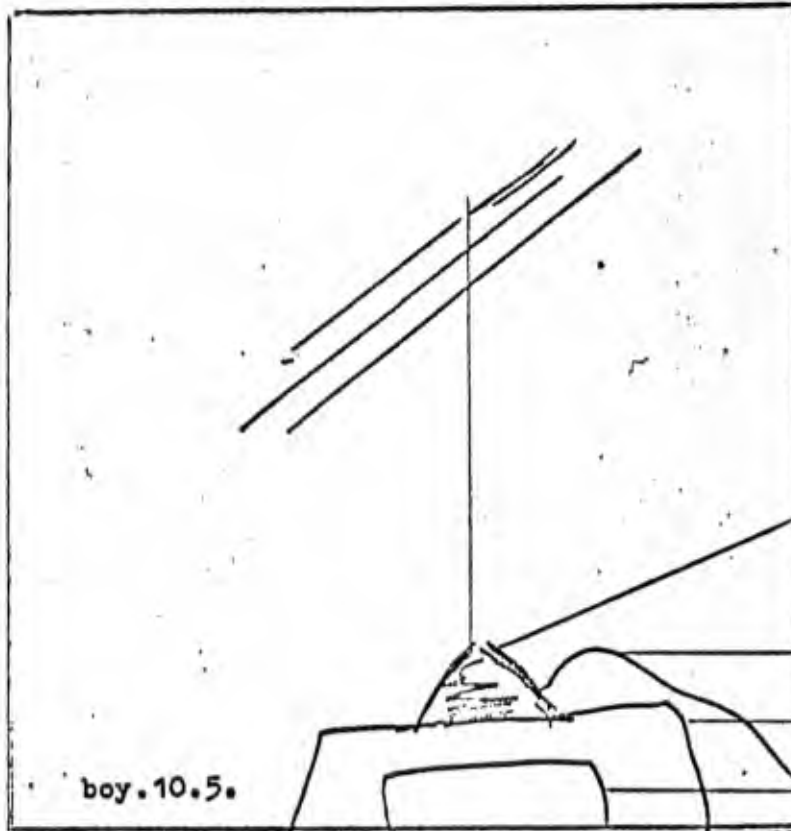
From the Elaboration Task (second item)

In general, there were marked qualitative improvements with age in this elaboration task. Interest here, is with the subject's ability to apprehend, define and re-define a stimulus, and on the basis of apprehension and definition to perceive potential. It would seem that re-definition comes more easily with age.

In an earlier part of this research, criticism was levelled at Torrance's method of scoring in his Elaboration Task (1974). His concern was not so much with apprehension and re-definition of a stimulus, but with quantitative elaboration. An example of his method of scoring was included. As a basic interest of this research is with categories of assessment the attempts of two children were rated according to Torrance and then considered in the light of categories employed here (see PLATE 21).

As can be seen, two subjects in the same age group, using the same stimulus lines, gain similar scores on the Torrance method of scoring. It is likely that they would score differently in terms of uniqueness, but again this would be 'statistical uniqueness' - in other words, sample specific. Whilst both subjects gain similar Elaboration Scores according to Torrance's method, there are very real differences in the nature of their elaborations. In the first instance (i), the stimulus lines dominate the form of the finished elaboration. In the second (ii), the subject integrates the stimulus lines into a new identity. It is the apprehension and re-definition of the stimulus lines which leads to an important difference between these two elaborations, for which Torrance and others offer no real qualitative category. The second subject could in fact have gained a score of only 2 on the Torrance system (had she depicted only the glass and straw) but this would not have detracted from the essential conception, neither do details, for which further points would be given, add to the nature of conception.

PLATE 21



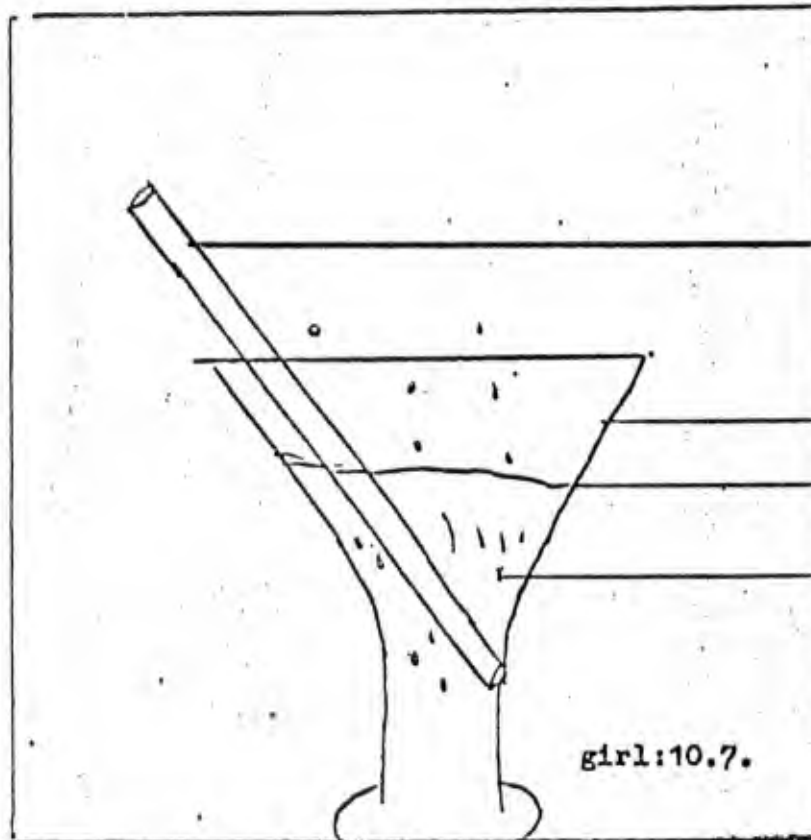
stand =1

wire =1

television =1

screen =1

score = 4.



straw =1

glass =1

liquid =1

bubbles =1

score = 4

Scoring of the Elaboration Task according to
Torrance.

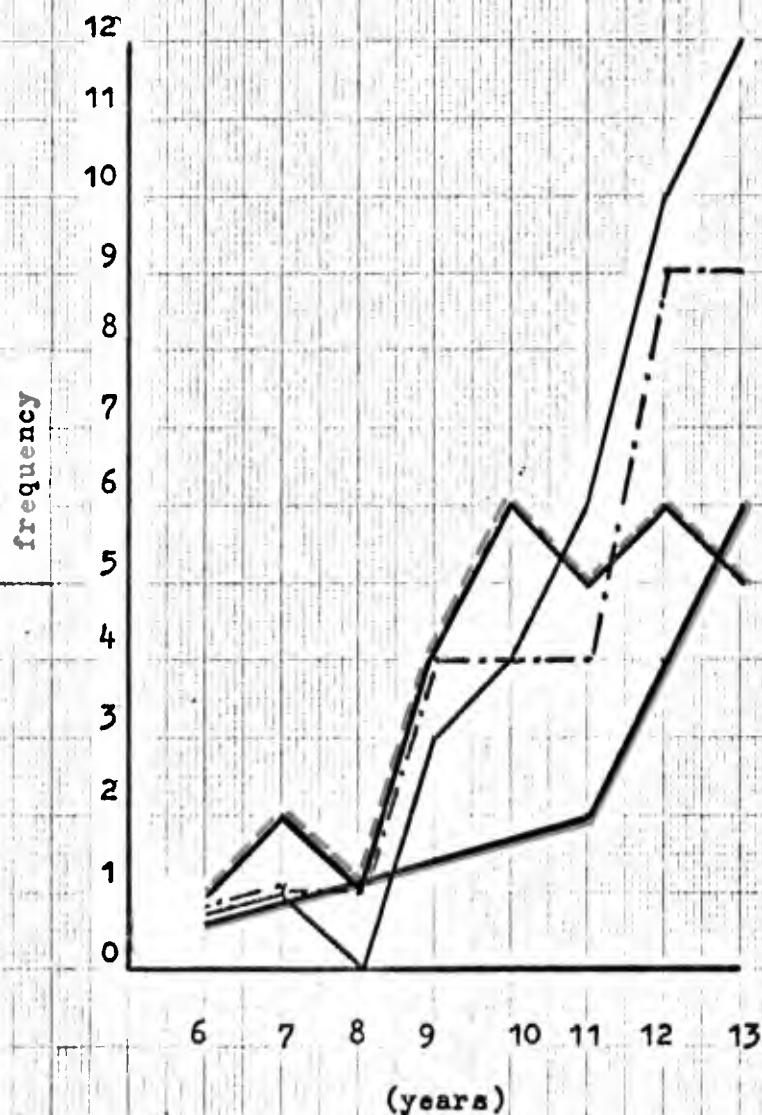
In this task alone, the use of categories (e.g. re-definition, embeddedness) concerned to assess different conceptions and consciousness of such conceptions, has led to conclusions of a nature somewhat distant from statistical assessments. Elaborations or additions in themselves can be meaningless. It is the essential idea itself which may or may not lead to 'creativity' - or to re-construction of reality.

FREE PROBLEM SOLVING

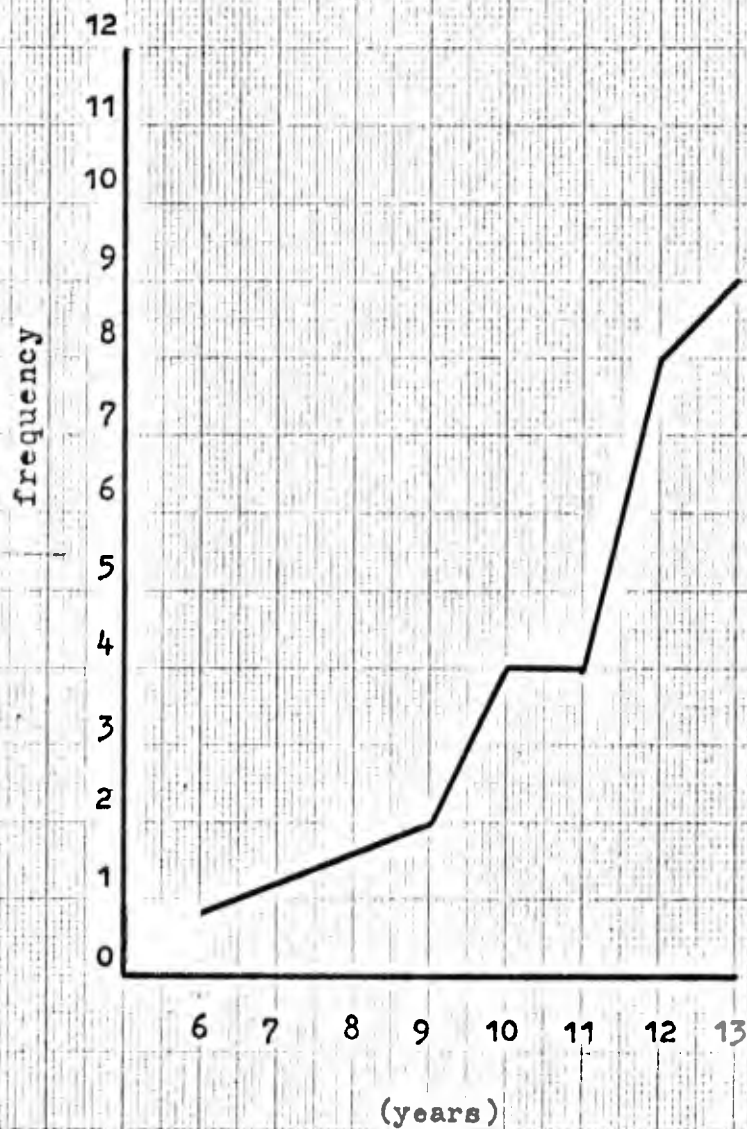
Almost all of the subjects in the youngest age group were able to produce at least one triangle (9/12), but they limited their output because they confined their attempts to an equilateral type triangle and were very concerned that the matchsticks should not overlap but touch end to end. They spent more time exploring and trying out combinations than did the older age-groups and seemed hindered by the belief that triangles could only be made from 3 or 5 matchsticks. None of them, in spite of repeated instructions that: "you may do anything you like with the matches" - broke the matchsticks. In all the 6 and 7 year olds produced only 7 different solutions to the Matchstick Problem and the sum of their individual scores was low (41) as opposed to 78 for the 8-9 year old group. Once they had achieved a solution, the 6-7 year olds tended to present this same construction from varied angles: older subjects realised that it was in fact the same construction and generally did not offer it again. The younger subjects also presented a number of errors as efforts to be recorded.

In the 8 and 9 year old group, 7/24 broke the matches in order to offer further solutions to the problem and there was an increase in the variety of solutions offered and in the sum of the individual scores.

A BREAKDOWN OF THE FREE PROBLEM SOLVING TASK
BY AGE.



————— = paradigmatic variations.)
 - - - - - = at least 5 solutions.) matchstick
 ————— = organised response.) problem.
 - - - - - = partly organised response.) bottle-top
 ————— = partly organised response.) problem.

FREE PROBLEM SOLVING TASK BY AGE.

Some attempts by the 6 and 7 year old age groups to solve the matchstick problem.

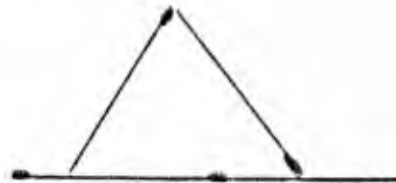


i.

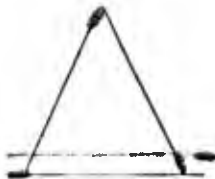
the above was generally the first solution to be offered - attained by making a triangle from three matches then attempting to fit the fourth match in by flattening the other out.



a.



b.



c.



d.



e.

in all this age group offered only 4 different solutions. (a.b.c. and i. which was a variation on b.)

d. and e. include some of their errors.

when questioned on e. this age group said that there were 2 triangles. by the age of 12 most Ss. replied that there were in fact three - or at least the triangle could be so interpreted.

This trend continued to rise with age and in the 12 and 13 year old group, 9/24 subjects broke the matches to produce further solutions and the sum of individual scores rose to 148 as compared with 41 for the 6 and 7 year olds. Further, this older age group tended to offer more flexible solutions, not being tied to the idea of the equilateral triangle and overlapping the matchsticks without first seeking permission to do so.

In general, the younger subjects (especially the 6 and 7 year olds) were slow to generate further solutions. The discovery of one solution did not seem to open up future possibilities - each solution was a new discovery arrived at by exploratory manipulation of the matchsticks. The oldest subjects generally applied a more systematic approach holding a basic model in their minds, varying it as much as possible, then changing to another model when the possibilities of one seemed to be exhausted. There was less manipulation of the matchsticks - they clearly thought up their solutions and were quicker and more fluent in their efforts. The only manipulation of matchsticks in the eldest group took place when they were evidently moving from one 'mental model' and searching for another. Younger subjects were so unaware of this way of working that they usually failed to recognise repeat solutions; older subjects were generally aware when they bordered on a repeat solution. It is anticipated that younger subjects would find it very hard to attempt this problem without the use of matchsticks for this would involve a re-structuring of reality in a non-concrete way. The observations here indicate that a purely statistical count on the basis of output can be very inadequate. Certainly there was an increase of output with age but there were also differences in the method of approach and the solutions of the older subjects were more varied and flexible.

It is suggested that fluency could be affected by training or experience. Such training might aim to enable the use of a basic paradigm, and systematic exploration of that paradigm. The usefulness of such basic training will be considered in the second part of this research.

Solutions offered to the matchstick problem

(concrete re-structurings by age groups)

There was a clear increase in the variety of solutions with age but there were also variations in:

- a) the approach to the problem;
- b) the type of solution offered.

Number of varied solutions by age

6 years = 4 solutions	10 years = 10 solutions
7 years = 6 solutions	11 years = 10 solutions
8 years = 7 solutions	12 years = 17 solutions
9 years = 9 solutions	13 years = 19 solutions

Approach to the problem

In general, younger subjects had a very step by step approach, having to 'discover' each new solution. Further, the discovery of one solution did not seem to lead to the generation of further solutions. Older subjects were able to offer a solution then envisage variations of that solutions.

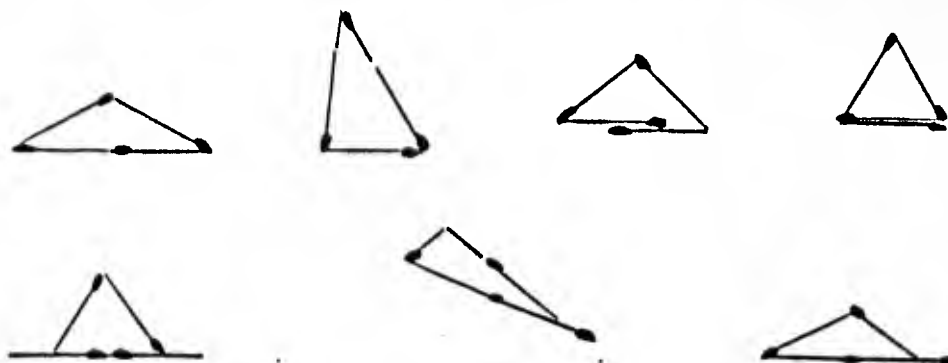
Types of solution offered

Younger age groups (6 years to 9 years) were less flexible in their use of the matchsticks being generally tied to the idea of an equilateral triangle.

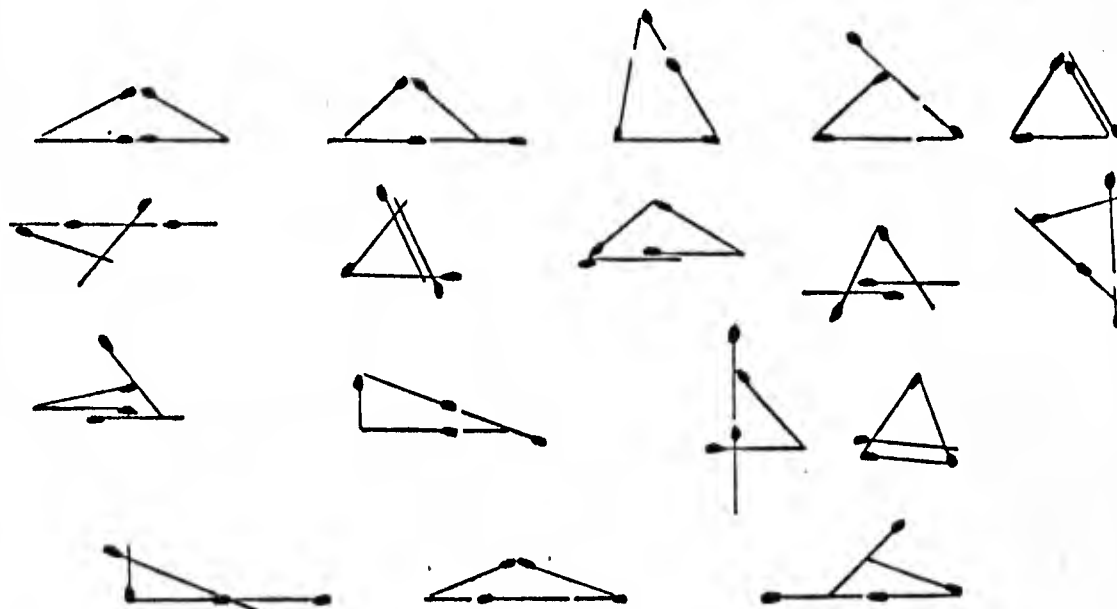
The diagrams over the page illustrate some age-group differences in terms of variety of solutions.

PLATE 23

Types of solutions offered illustrating the increased flexibility of older subjects.



The above solutions were offered by the 8 year old group who managed 7 variations, the sum of their individual scores being 30.



The above solutions were offered by the 12 year old group who managed 17 variations, the sum of their individual scores being 56. The 13 year old group offered 19 variations with a group score of 54.

BOTTLE TOP PROBLEM

The intention with this problem was, as with the previous matchstick problem, to observe how systematically - if at all - subjects could go about offering a solution. A picture of a bottle top was provided so that subjects could check their efforts against the nature and shape of the bottle neck. Few of the younger subjects used the picture in fact; more of the older subjects did. Until nine years of age most of the solutions offered were non-systematic, consisting of isolated and non-related ideas or bizarre solutions, not at all practical and out of all proportion to the task in hand. From 10 years onwards, there was a movement towards more systematic thinking but it was only at 13 years of age that a number of subjects (6/12) were able to put forward a systematic and organised solution to the problem. The following extracts illustrate some of the types of solutions put forward at different ages.

girl 6:8

"Get a piece of wood and a knife and then you get 3 matchsticks ... then you put that near the bottle ... you glue it all together. Then you get a sharp knife and put it near the top. Then you get a big heavy stone and smash the top off and the matchsticks fall down and it comes off."

(non-systematic solution)

boy 7:7

"You get plasticine. Shape it like the bottle ... make it quite hard. Put metal over then put it on a machine that makes it go round. Then put it on the bottle, then pull it off."

(How would you actually take it off - with your hands?)

"Yes."

(Do you really need the plasticine then?)

"Yes."

(Why is that?)

"I don't know. You need it to get the top off."

(non-systematic solution)

This type of solution continued strongly until the 10 year old group when a more systematic type of thinking appeared. Few subjects in the 6, 7 and 8 year old groups seemed to generate an idea in relation to the

bottle, and few seemed able to assess the effectiveness of their efforts. From time to time, subjects did appear to relate parts of their solution to other parts of it - but rarely to the task in hand - namely the bottle top. Responses varied therefore from: "grow big teeth then rip it off with your teeth" to: "fix it in a stand then shoot the top off with a gun". Without doubt, many solutions were rooted in disorganised thought and phantasy - none were rooted in creativity in the sense of ability to structure and re-structure reality.

From 10 years onwards, there was a steady movement towards more systematic solutions, and this pattern continued until 13 years when non-systematic solutions almost disappeared and fully systematic and organised solutions increased.

girl 9:9

"Well you could make a machine that would cut the glass somewhere round here (indicates neck of bottle) but so you wouldn't have any cracks of glass in your mouth - put a rubber thing around where it would cut."

(towards a systematic solution)

While the above solution is still unclear and lacking in implication the subject would appear to be more aware of the nature of the problem, and she is aware of some of the implications - i.e. broken glass in your mouth. However, the actual machine and its functioning is not explained.

boy 10:9

"A sort of hand crane and the crane comes down - you let it down on its string - and you put it on the bottle top, then fix the two hooks onto the bottle and wind it off."

(towards a systematic solution)

The 10-11 year old age group ranged across the three types of response, showing the beginnings of systematic thinking.

boy 11:6

"You'd get a machine. The machine would be made of a knife thing which goes round the top of the bottle and snips the top off clean so that no glass would go in the lemonade. The knife would be a rounded pair of scissors."

(towards a systematic solution)

girl 12:7

"A small gadget which fits into your hand. At the end it would have four hooks which would be open and loose when you wouldn't be using it. You put the hooks on the bottle top then pull a small lever on the gadget. This would make the hooks close around the top of the bottle and open it sort of upwards. It would grab the sides of the top and flatten it upwards then crumple it up. When the top was off you'd let go of the lever and the hooks would go loose again."

(a systematic solution)

boy 13:6

"You could do this if you made the tops a different way. When you make the tops in the factory you make the edges of the top of like soft tinfoil. Only the middle of the top would be really hard. When the top was put on you'd press the soft edges down round the neck of the bottle, then you'd fit a metal strip around these edges to keep them in place. You'd stick this metal strip down. You'd leave a little bit sticking up. When you want to open it you pull the little bit sticking up and take the strip off, then you would just lift off the rest of the top with your fingers. The edges would be soft so it would be easy."

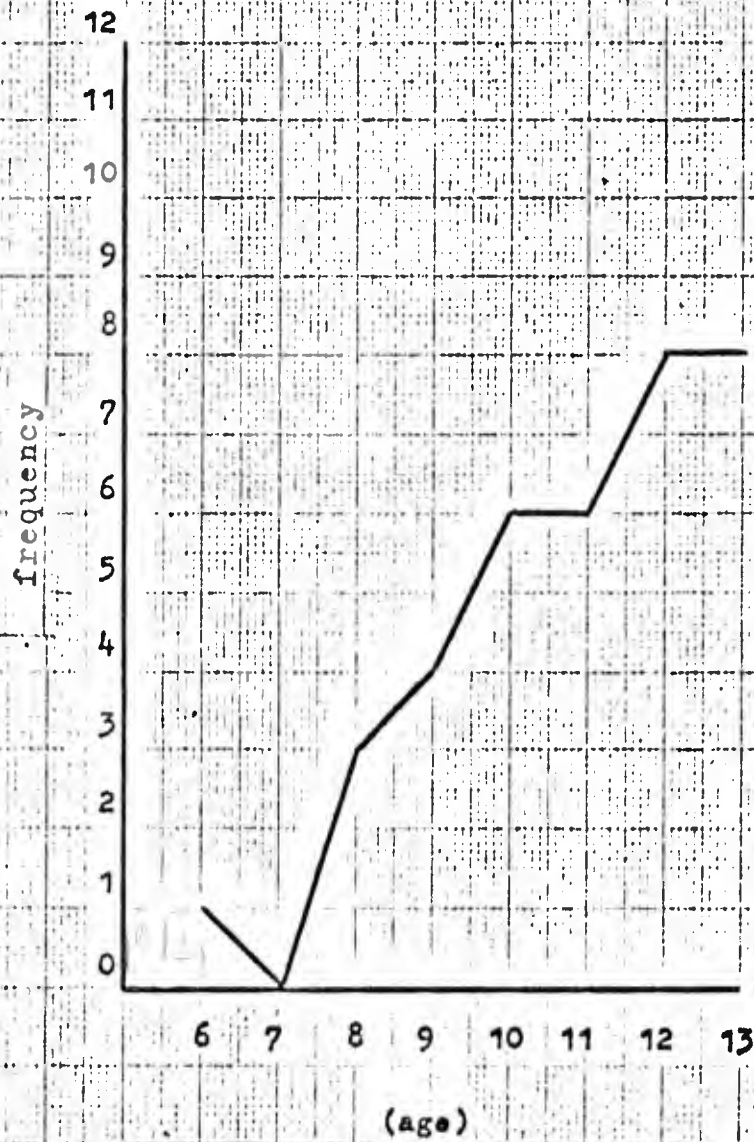
(a systematic solution)

In the 12 and 13 year old age group, 10 subjects on a possible 24 offered the above type of systematic solution. With development and age one would expect this type of response to increase. Clearly, it is only at this stage that subjects are really able to define the problem to themselves, to organise a solution and to be aware of the implications of each step. Younger subjects offered more 'unusual solutions' but they could not on the whole be regarded as true solutions, which is why, yet again, a statistical count of efforts is regarded as inappropriate. While the partially systematic solutions are still not true solutions, they are important in a transitional sense in that they indicate adjustments in the child's thought and the direction towards which he is moving. Such observations are essential to an understanding of the nature of the child's solutions at different stages.

A BREAKDOWN OF IDENTITY RECOGNITION BY AGE.



- = use of stimulus lines.
 - - - - - = purposeful drawing (i.e. could name outcome)
 ————— = uses at least 1/3 of stimulus lines.
 = re-defines the stimulus lines.

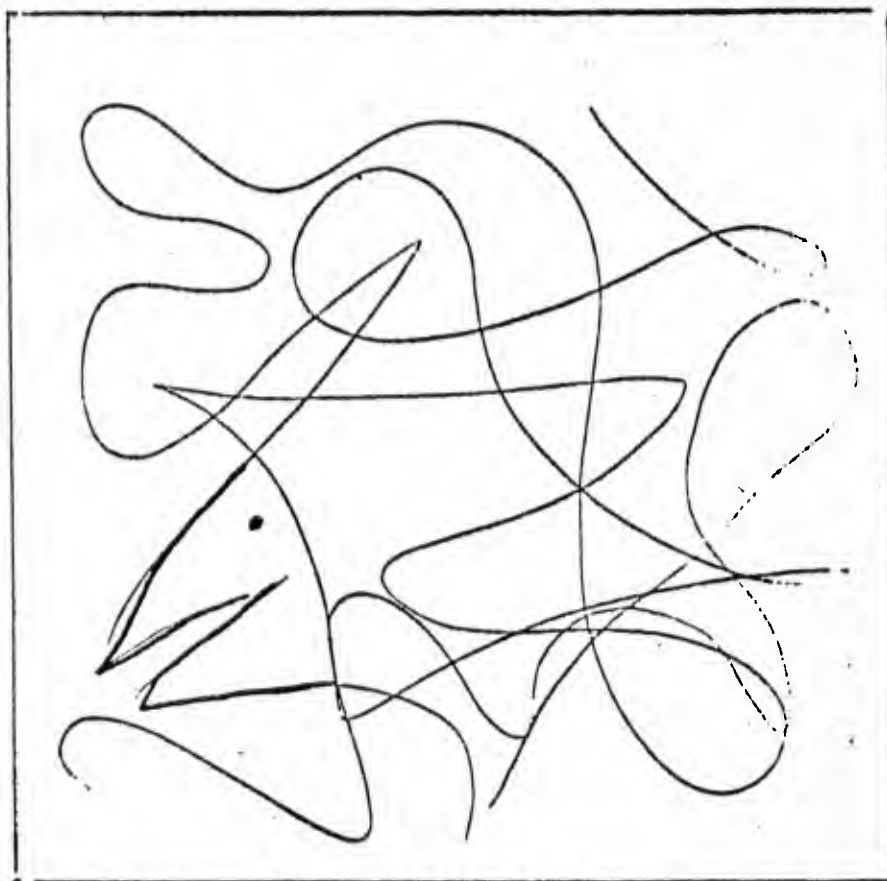
IDENTITY RECOGNITION BY AGE.

IDENTITY RECOGNITION BY AGE

In this Identity Recognition Task, focus was again on the nature and type of response. The most striking feature, in general terms, amongst the 6 to 8 (and even 9) year olds, was their inability to use the stimulus lines and to identify objects or shapes in them. Only 6/12 of the 6 year old group actually used the lines as opposed to drawing beside them and by 8 years of age still only half of the subjects in this group were using the lines. Until 9 years of age (inclusive), half of the subjects were still drawing without any purpose, not knowing what their attempt would turn out to be. Within the 6-7 year old band only 2/24 subjects were using at least one-third of the stimulus lines: most of the others were identifying small fragmented shapes which they were unable to name.

By 9 years there was a definite drop in this aimless type of outlining, and an increase in ability to use at least one-third of the stimulus lines and to identify whole objects. The 12 and 13 year old group were concerned about accuracy and generally showed dissatisfaction with their own attempts. Whilst they picked out recognisable shapes, the 9 year olds were able to accept certain inaccuracies, sometimes re-naming the object to fit them.

By 12 and 13 years of age, subjects were identifying larger (in the sense that 13/24 used at least one-third of the stimulus lines) and more intricate shapes and objects. They followed them through carefully re-evaluating their efforts as they drew and managing not to be distracted by parts of the stimulus lines which cut across their identifications. Younger subjects found it difficult to ignore this distraction, and would more often follow a line, realising afterwards that it did not contribute to their identification.

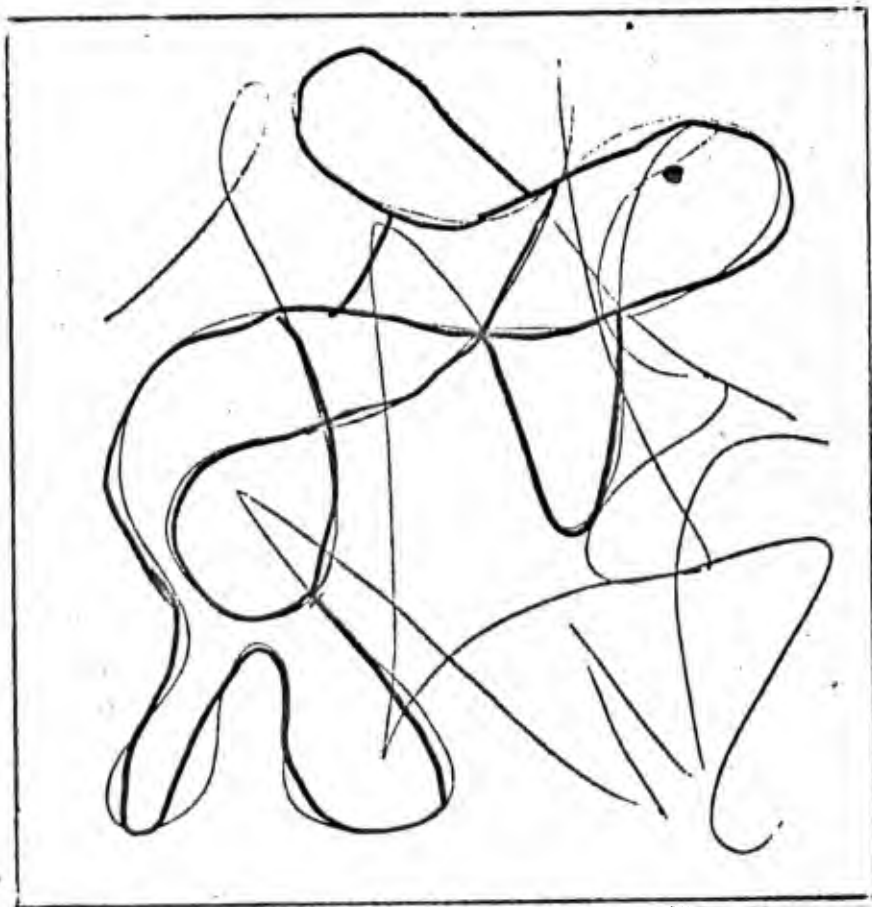
PLATE 24

girl. 6:7 years.

An example of limited use of the stimulus lines.

This child identified a "fish's head" but made ^{no} attempt to carry the identification further as did older subjects. More, she picked out the lines without knowing what they would become.

From the Identity Reconstruction Task (Item 1)

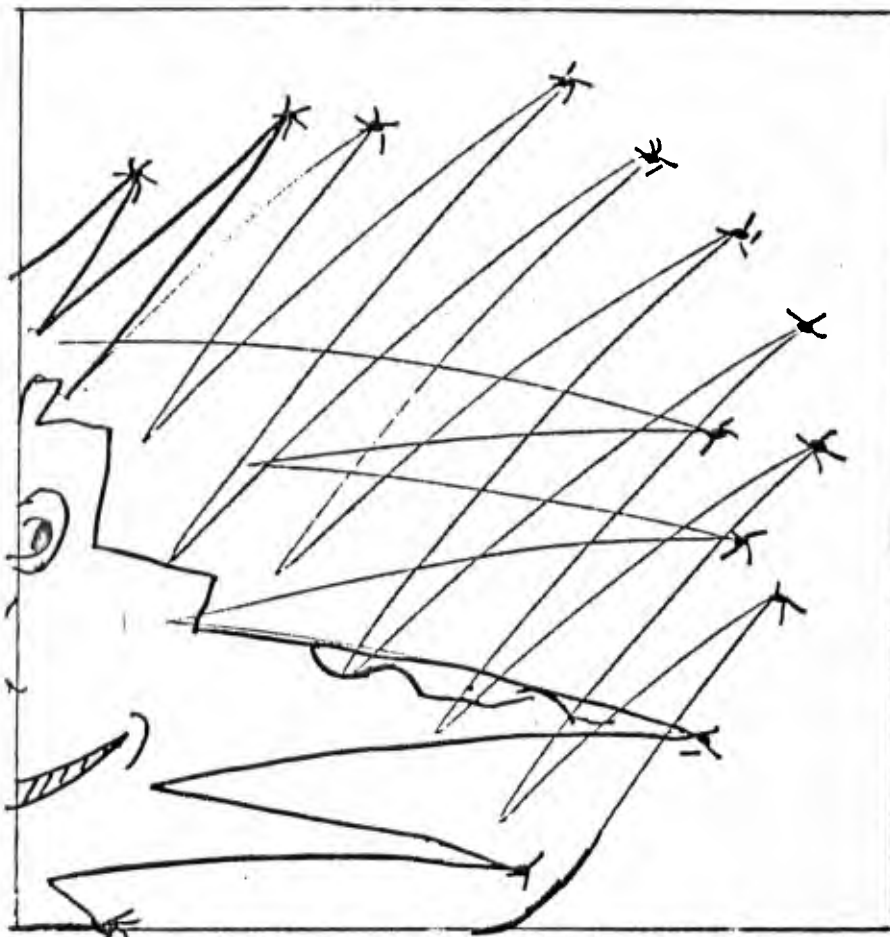
PLATE 25

girl. 9:7 years.

Subjects in this age-group were using a greater amount of the stimulus lines.

The above identification was called - "a twisting fish"

From the Identity Recognition Task (item 2)

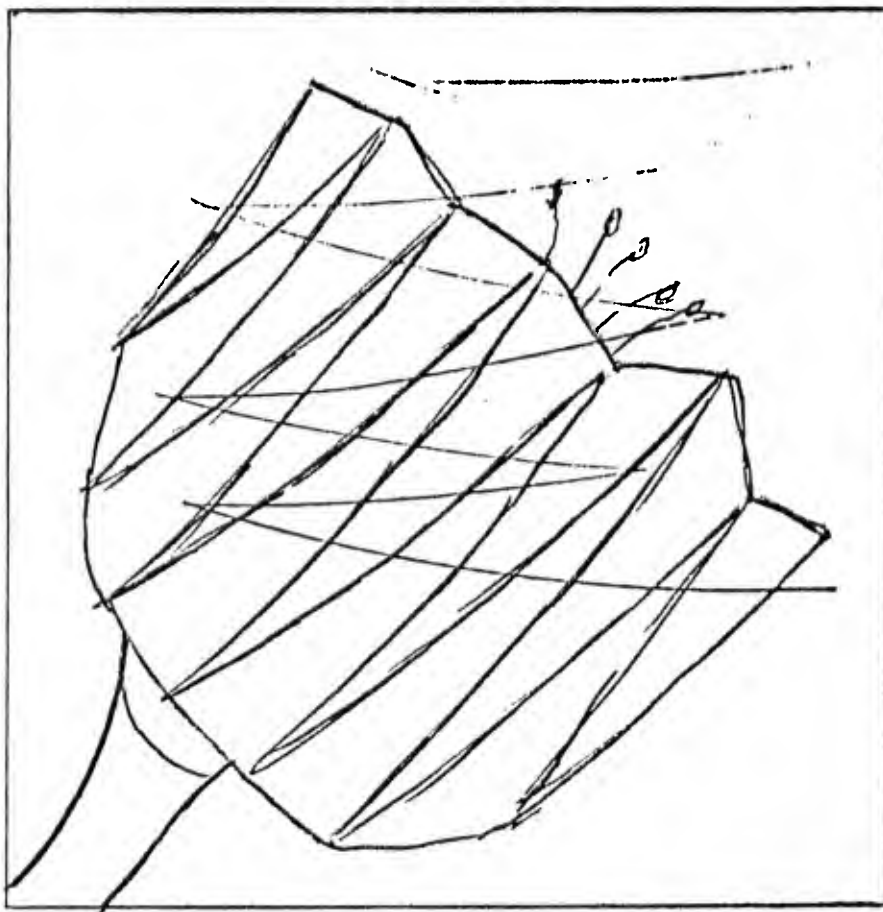
PLATE 26

"Jack-Frost"

boy. 9:10.

From this age-group onwards Ss. began to show an ability to carry their idea beyond the frame provided and to identify only a part of the object. Younger Ss. tried rather to contain their effort within the frame and would sometimes distort it to make it fit.

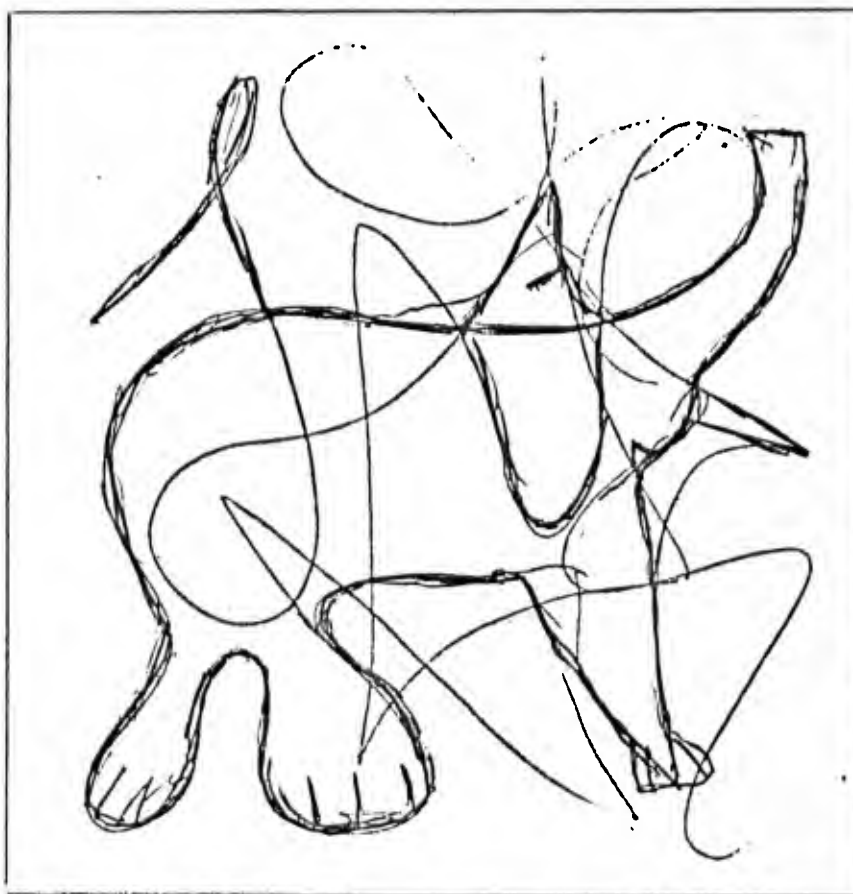
From the Identity Recognition Task (2nd. Item)

PLATE 27

girl. 10:9.

Ss. in this age group were just beginning to use most of the stimulus lines in this task. Younger Ss. tended more to use fragments of the lines - turning them, in this particular task into objects such as daggers, spikes etc. The girl here turned all of the lines into a tulip.

From the Identity Recognition Task. (2nd Item)

PLATE 28

boy. 13.7.

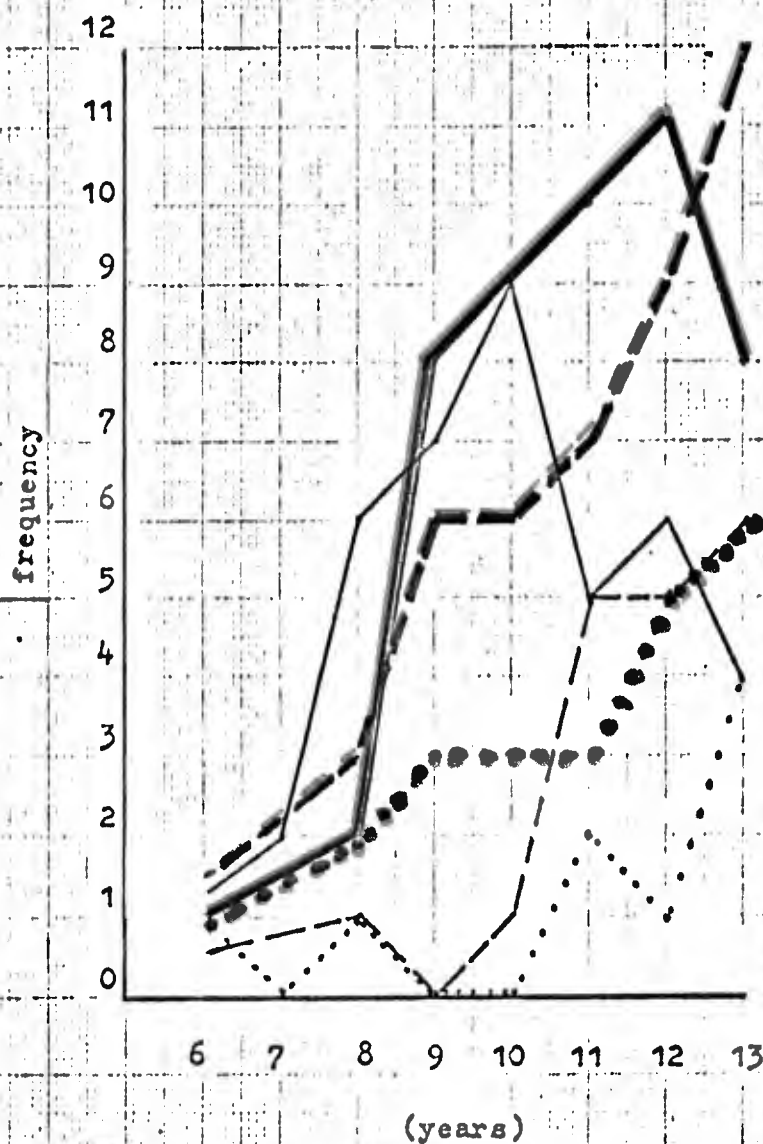
An item from the Identity Recognition Task. This response is very typical of the 13 year old Ss. of this sample. They scrutinised the stimulus lines with care and could always name their drawing before they began to carry it out. As a group they used at least one third of the stimulus lines and for the most part identified whole objects as opposed to small parts of objects or shapes. They were concerned about precision and yet were still able to recognise and identify objects when these were poorly conveyed by the stimulus lines (as in the above instance)

Identity Recognition Task. (first item)

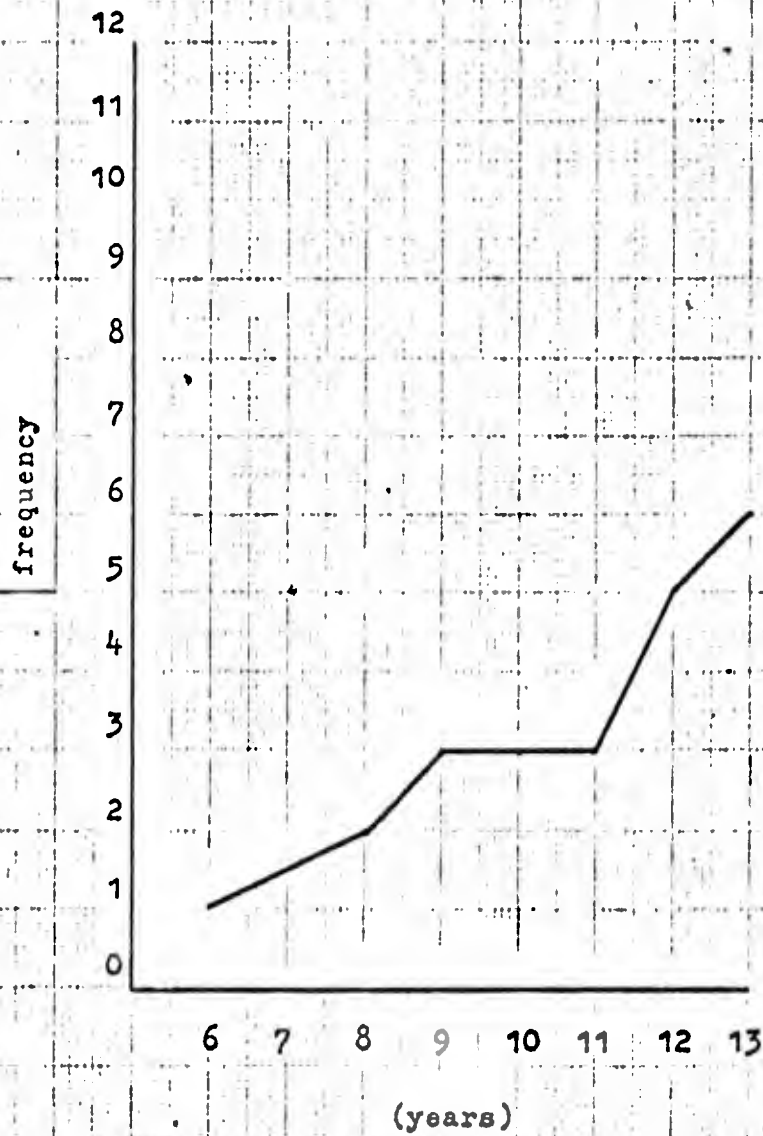
When re-constructing reality, an initial part of the task must be that of selecting aspects from the general contexts. How one selects and re-selects must play a determining role in terms of the nature of the outcome. Complex selections are more likely to lead to complex structurings and complex solutions. The usual context of such selections would, of course, be the medium in which one is working. In an assessment situation, there is a certain unavoidable artificiality, in that a context is selected (in this case stimulus lines). However, in both the 'life-context' and the assessment context much will depend upon the forms selected by the perceiver. A major problem in the re-structuring of reality will always involve the struggle to perceive and select 'new' forms which are not determined by set and experience. Constructions based on 'new' forms are more likely to lead to 'new' conclusions.

But before novelty can come about, there must exist basic abilities of organisation, which enable an individual to identify and define aspects of reality, and which enable him to do so with deliberation and consciousness of his own activity.

A BREAKDOWN OF IDENTITY RE-CONSTRUCTION BY AGE



- = definition partly organised.
- - - = definition organised.
- = re-construction correct on a unit basis.
- = re-construction correct on a non-unit basis.
- = division of structure correct.
- = change of the structure's shape correct.

IDENTITY RE-CONSTRUCTION (1) BY AGE.

IDENTITY RE-CONSTRUCTION (1) BY AGE

This task fell into four sections, the first requiring an accurate description of the material on the test card, the others involving re-constructions of this same material. One intention was to see if there might be an relationship between ability to define and describe and ability to act upon what was defined and described.

The test card depicted a simple one dimensional block of flats, 5 floors high with four square windows on every floor, except the ground floor which had four round ones. The intention was to present a limited amount of material in order to reduce complexity, especially for the younger subjects. As subjects had to re-structure this same material this consideration was yet more important. Even with such minimal information it was only at 12 years of age that subjects stopped missing out information in their descriptions. In the 10/11 year old age group, 6 subjects missed out information of an essential type, and three gave inaccurate information. Also, even by 12 years, only 5/12 subjects made any reference to size relations in their description.

Apart from offering very confused descriptions (especially the 6 and 7 year olds), younger subjects added information of an ego-centric nature:
boy 7:8

"It's got square windows. At the bottom there's round ones where you do the washing. There are people in there washing clothes. There's a washing room, then there's the kitchen here. There's a mummy here looking out of the window at her little boy playing down here. That's all."

Perhaps the most striking feature was the paucity of information (objective) derived from some of these younger subjects. Later, when they began their re-structuring tasks, their efforts here revealed that they had not, or were not able to take stock of the essential features of the building.

girl 6:8

"There's squares, round windows, lines and colours."

girl 6:7

"Lady looking out of the window - a dog (indicates the window here) - a snowman - a cat - a mouse - a kitchen - round windows at the bottom - a hamster."

During this description the child looked intently at the card. When asked: "Is there anything else I would need to know to draw what's on the card, she replied: "Yes, lines and grass."

boy 6:7

"Lines, squares, lines, squares and then round circles - then square lines - and the orange colour."

With the 8 and 9 year olds, there was a shift towards more objective descriptions but these still lacked organisation and only 4/12 made any reference to size relations. 13/24 offered more objective descriptions as against 10/24 who still persisted in largely ego-centric information composed of unrelated statements. Only one subject in this 8-9 year old group offered a truly organised definition.

boy 8:5

"It's square - got 12 square windows and 4 circle windows. 5 blocks high and it hasn't got any stairs."

(a more objective description)

girl 8:10

"Has 4 windows at the top, 4 on each later - 4 layers. 4 circles on the bottom layer - hasn't got no curtains. 12 altogether and four of circles."

(a more objective description)

girl 9:9

"It's an oblong standing up and its sort of checked, so that its got 4 along the top and 5 downwards. The first 4 rows have square ones and the last four have round windows."

(a more objective description)

There were exceptions in every age group but for the most part, subjects in the 8-9 years group fell into this middle range, moving towards more objective descriptions of an organised type.

By 11 years, 5/12 subjects produced well organised descriptions made up of objective information and three of them made references to size relations. This trend increased in the top age groups with 11/24 of the 12-13 year olds offering this third type of description.

girl 13:11

"It's a rectangular 5 story block of flats with 4 windows facing the front on each floor. The ground floor windows are round, all the others are square. The pattern of stone-work forms a kind of square outline around each of the windows, including the round ones. The drawing on the card is about 5" x 4" - I think, and the windows are about $\frac{1}{2}$ " square - on all the 4 sides. I think that's all."

(organised with objective information)

boy 12:6

"It's a block of flats 5 floors high. At the bottom there are 4 round windows. On the rest of the floors there are 4 square windows on each floor. There are 4 floors with square windows, so 16 square windows altogether - 20 windows with the round ones. The windows take up most of the front of the flat. The whole thing is... 6" wide."

(organised with objective information)

None of the subjects in this age group were offering ego-centric type descriptions but 13 had still not attained truly organised descriptions, and not all subjects falling into the category illustrated above were making reference to size relations. They were not, however, missing out information or being inaccurate in their descriptions.

Interestingly, five subjects in the 12/13 group added evaluative comments on the building - different in type from the ego-centric information given by younger subjects. Also, such comments were in addition to the description.

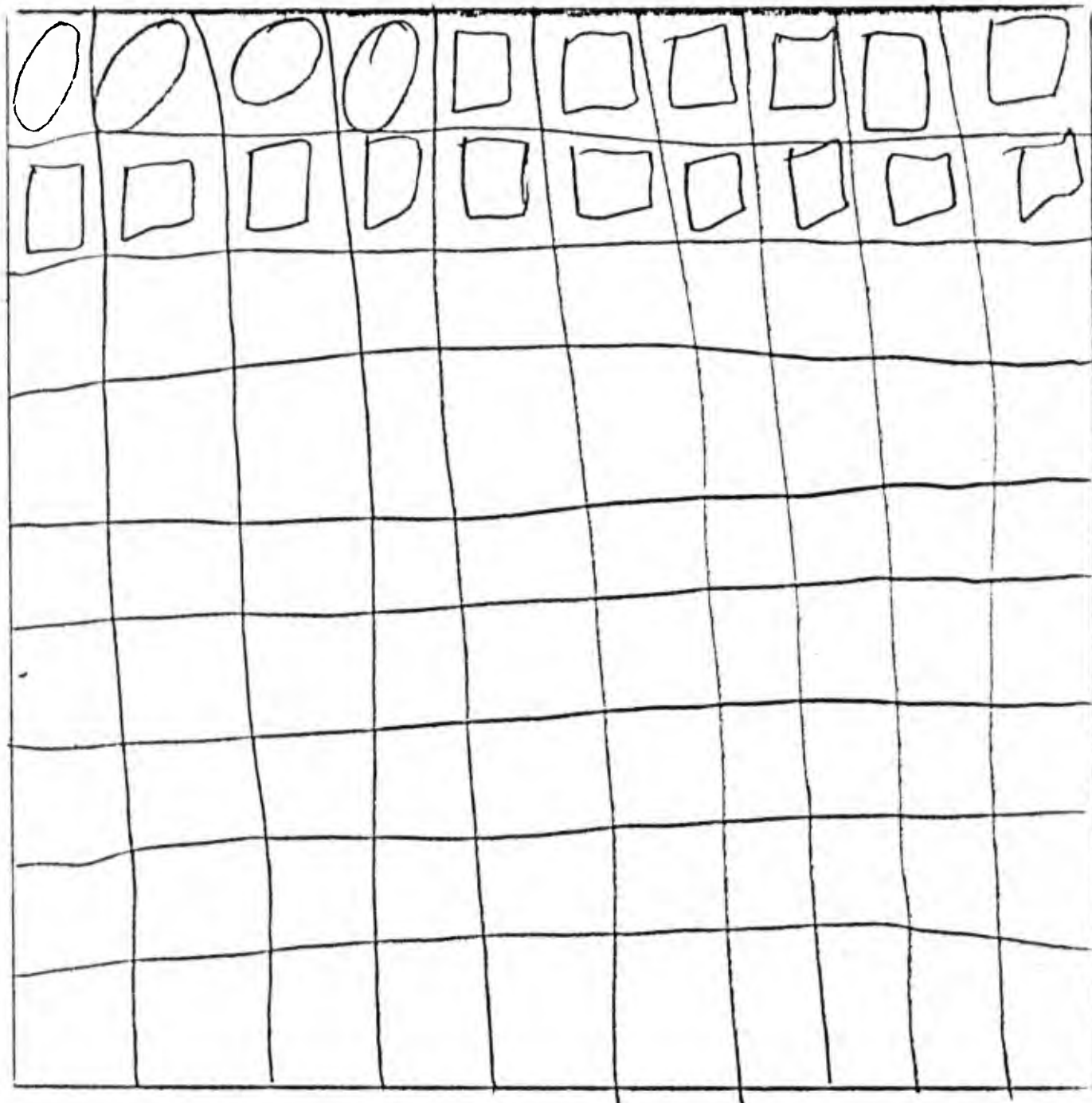
e.g. "... all the rooms look the same - I think this would not be good for people who have to live in flats like this. Also, they are very plain. They should be brighter." (girl 12:7)

IDENTITY RE-CONSTRUCTION

The re-construction tasks were concerned to look at ways in which subjects could re-structure information, objects, etc. In the initial task of describing, most of the 6 and 7 year olds showed clearly that they paid little attention to the number of units and other essential features of the building; most missed out information or gave inaccurate information. It was expected that this would show up in the following tasks.

The first re-construction task - "make the building different in some way" - left the way free for the subjects. This was deliberate. Later tasks forced them to deal with the units in increasingly difficult ways. Out of the 6 and 7 year old group, only 1/24 could correctly "change the building in some way". 12/24 illustrated a very poor concept of a building - putting all the units into one corner or spreading them over the paper into "space" that could not exist given the number and type of units comprising the building. About half of the group began without ever counting the units. Those who did count were clearly unable to envisage what the finished product could look like. This was obvious from instances when the child began confidently, having drawn a rectangle, then realised that he could not 'fill' the rectangle with the number of units he had to use. Some attempted to cope by cutting a bit off the rectangle, spreading the remaining units out to fill more space or adding doors and 'concrete strips' to fill the space - though they were told repeatedly that they could not add anything or take anything away. Illustrations on the following pages explain these points.

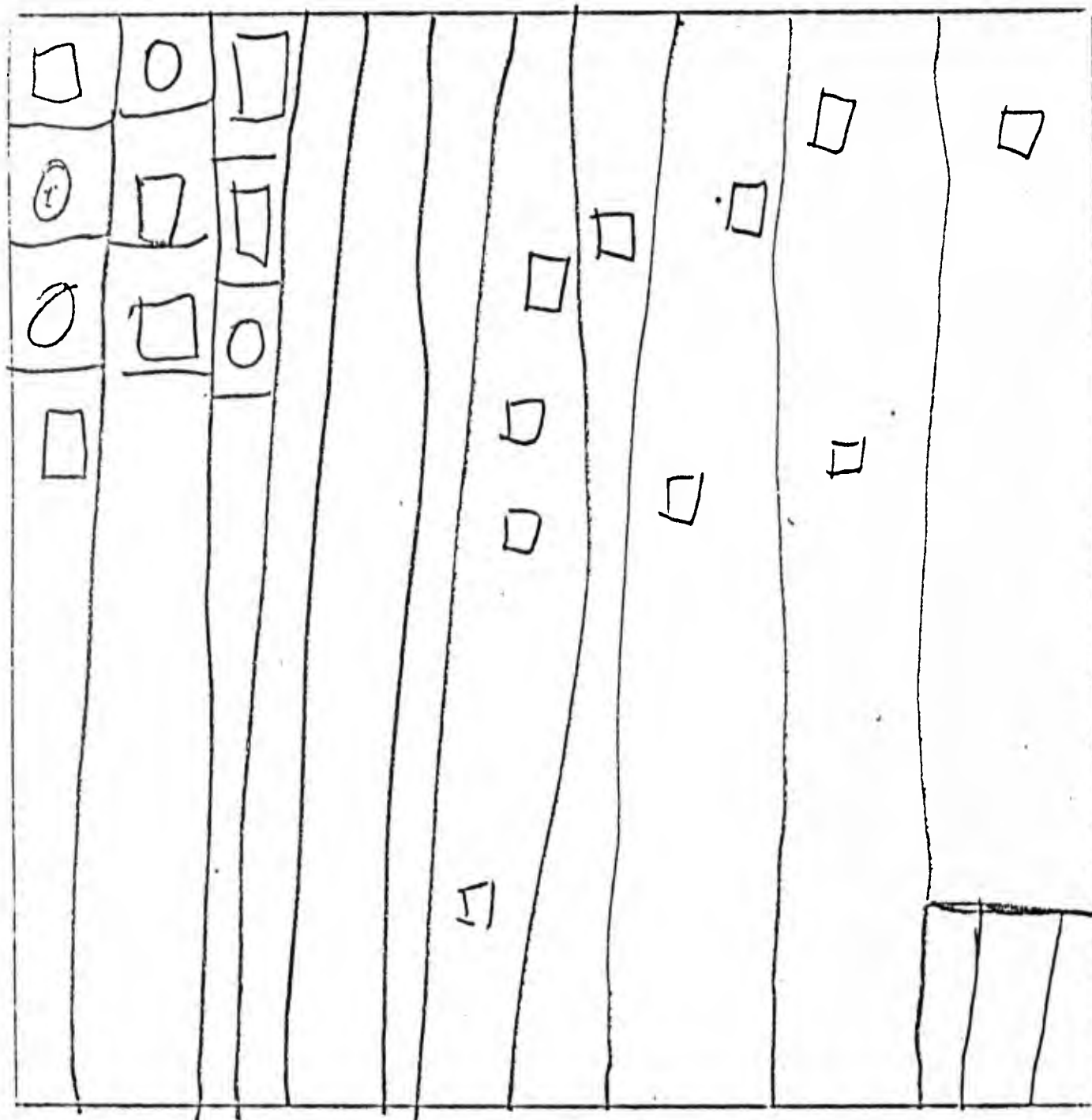
By 10 years of age the majority of the subjects (9/12) could change the building correctly, but even up until the 13 year old age group, the majority preferred to maintain the rectangle, and simply effect the change by varying the position of the units. After 10 years, there were no actual errors in this task.



boy. 7:7. attempt to change the model in some way.

PLATE 29

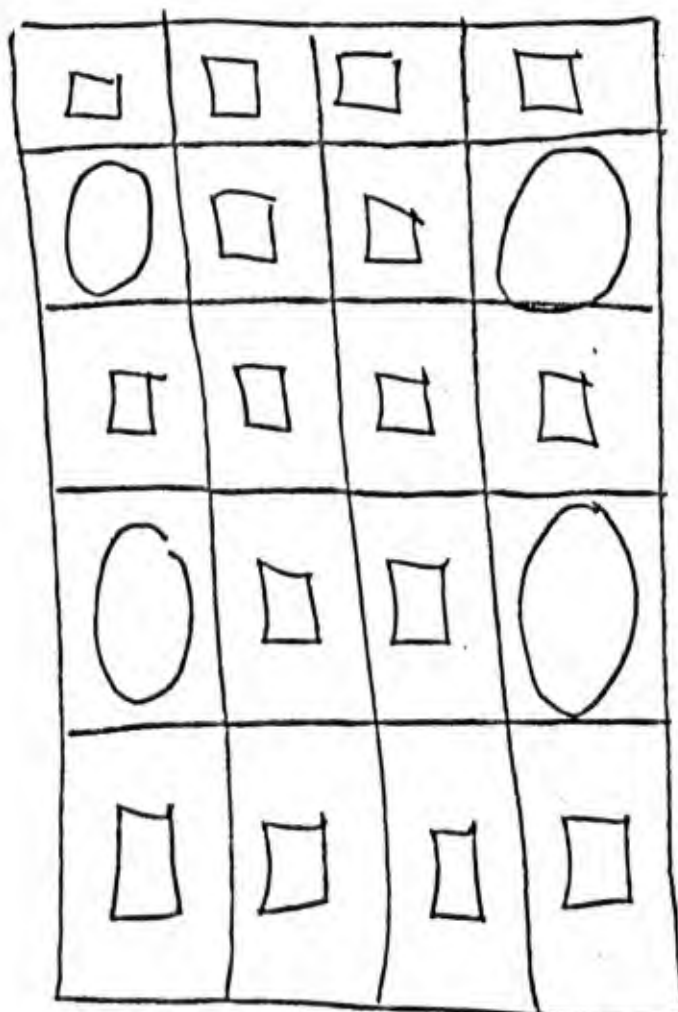
without any assessment of the model this subject immediately divided the whole of the section into pieces. By chance he divided into rows of ten but he only discovered this by counting twice across. he also counted down. after filling in the four circles correctly he then filled in the squares along the top row and counted again. he filled in 6 more squares and re-counted. when he got to the end and realised he had used all the blocks available he commented that he didn't know what to do with the rest of the spaces.



girl. 7:6. attempt to make the building different
by re-organising the component parts.

PLATE 30

like the previous subject this child immediately divided up her paper without counting. she then filled in some squares and circles in the top left hand corner. after a while she realised that she could not fill up the whole space so decided to spread the squares across the whole, adding a door.



boy. 11:8. attempt to make the building look different
in some way.

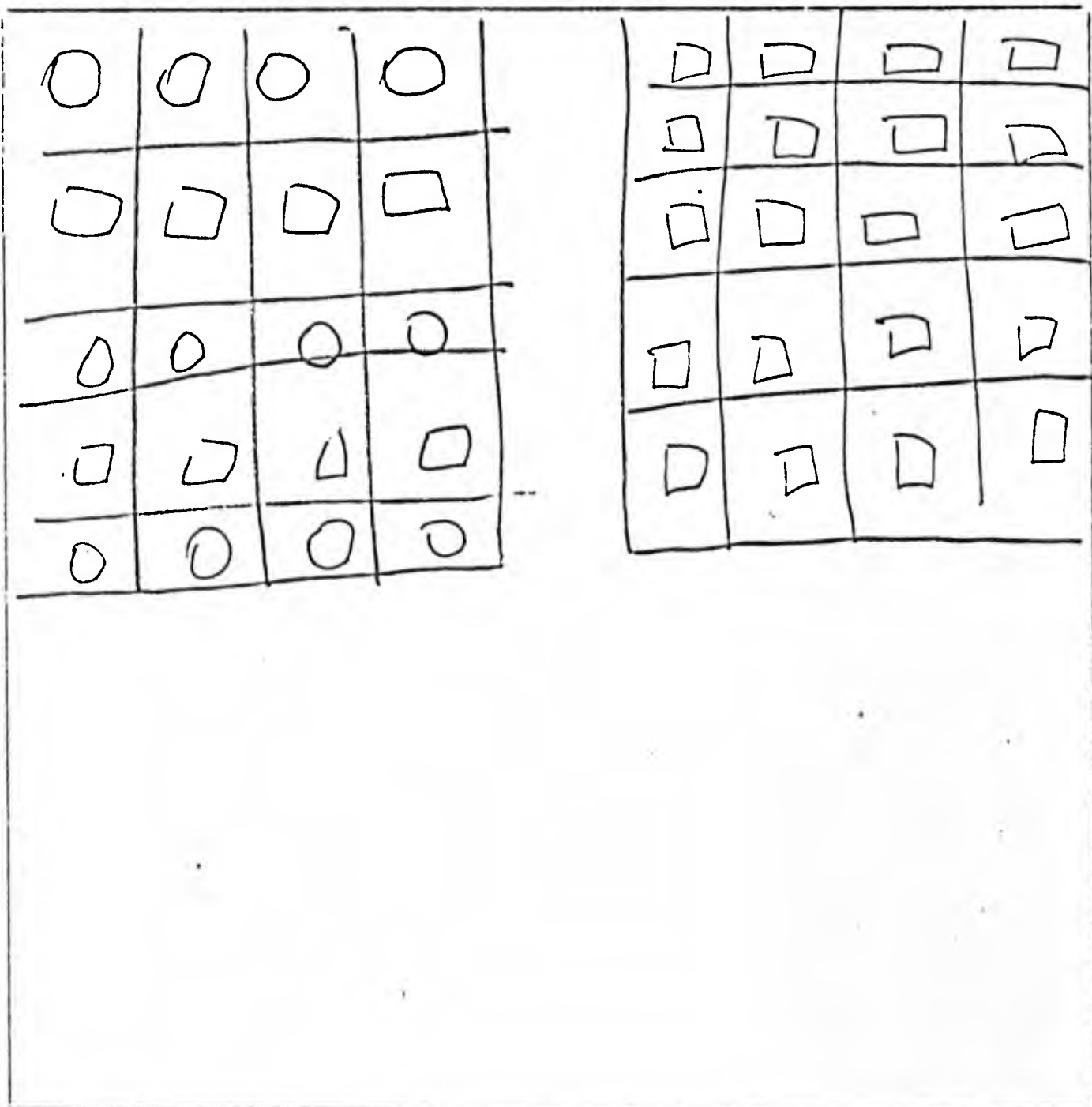
PLATE 31

like most subjects in this age group, the boy here did not depart from the rectangular shape of the building but chose to vary the position of the circles. a girl choosing the same solution, considered a more radical variation (of shape) but said she would get it wrong were she to try it.

In task 3 of Identity Re-construction (1), a more fundamental grasp of the units comprising the building was required - especially because the division of the building was to be unequal. As can be seen from examples of attempts, some younger subjects totally ignored or failed to grasp the constraints (structural) of the units. Some of the younger subjects managed an equal division - by merely drawing a line down the centre of the building, but because they failed to regard the building in terms of units, they were unable to move from this stage of equal division to one of unequal division. Further, some subjects had difficulty in allocating the correct number of windows to each building - e.g. one subject put four round windows in each building - instead of 2 in each.

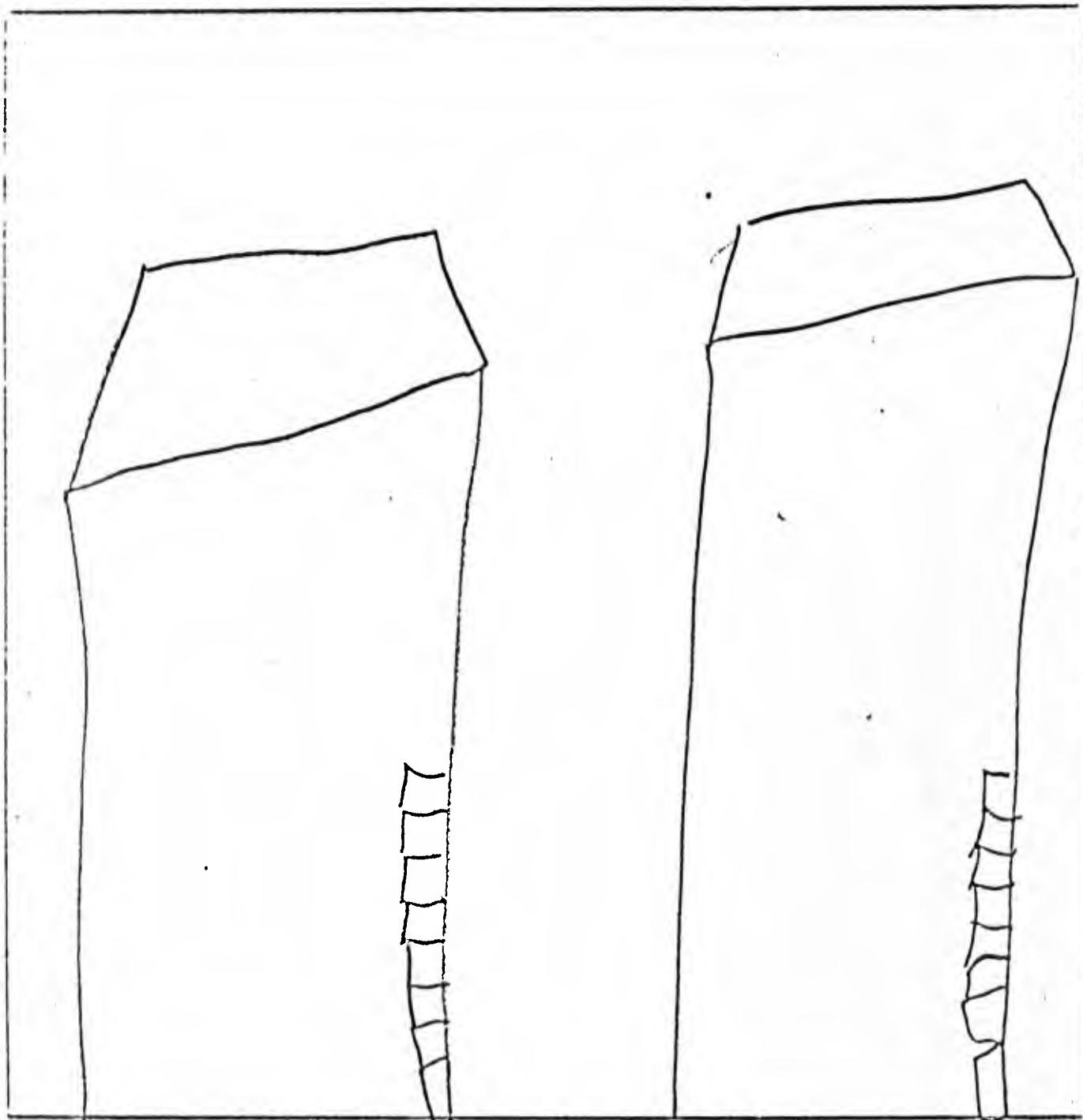
By nine years of age, half of the subjects could carry out this task correctly and in the 13 year old age group all of the subjects were able to handle it with ease.

True re-construction of an object or event requires that the individual understand the structure of that same object or event, for a structure is defined and formed by its component parts. A change in any one of those parts will lead to a change in the total structure. Young subjects seemed unable to perceive the reality in such terms. Their changes in this particular identity - a building - were in fact distortions. They were unable to shift their definition from a 'whole' to the parts of that whole. Real grasp would enable a subject to make yet further sub-divisions realising that any one object can be perceived and re-perceived very differently according to the criteria employed.



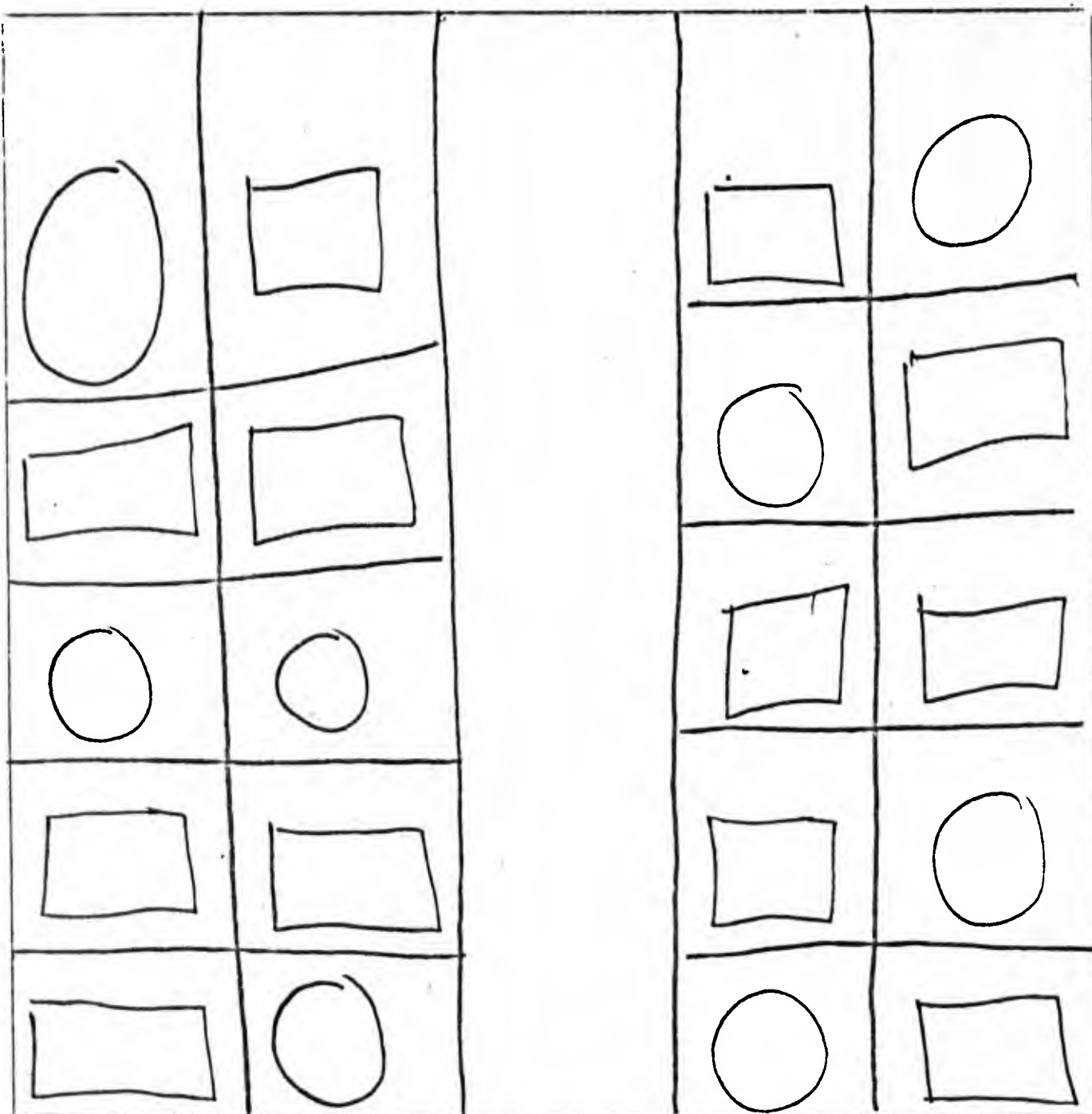
girl. 7:4. attempt to make two buildings out of one. PLATE 32.

this subject began by counting the squares in the original model and the went on to draw 2 buildings with twice as many squares and circles as there should have been. at the end she was challenged on this. counted again and noted a discrepancy, but explained this away by saying here buildings were smaller and so it was right.



girl .7:6. another attempt to make two buildings
out of one. PLATE 33.

this subject instantly drew two buildings and then counted the blocks. she left out the circles completely and simply added the correct number of squares onto the side of the buildings. when questioned she appeared to be quite satisfied about the buildings, and not concerned about the spatial issues.



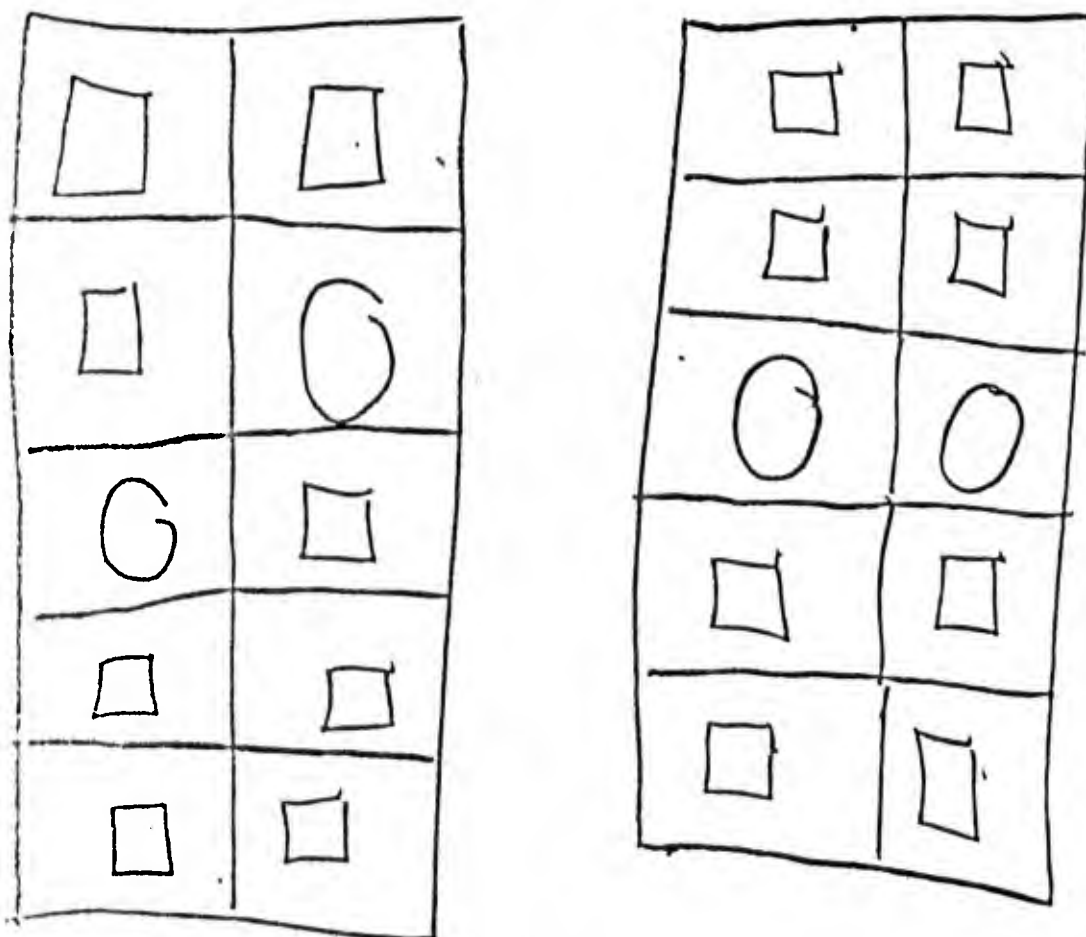
"two buildings out of one building"

boy. 10:5.

PLATE 34

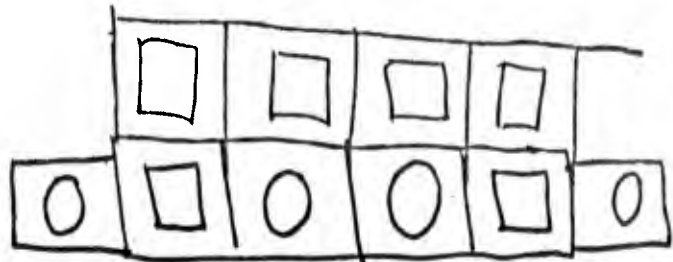
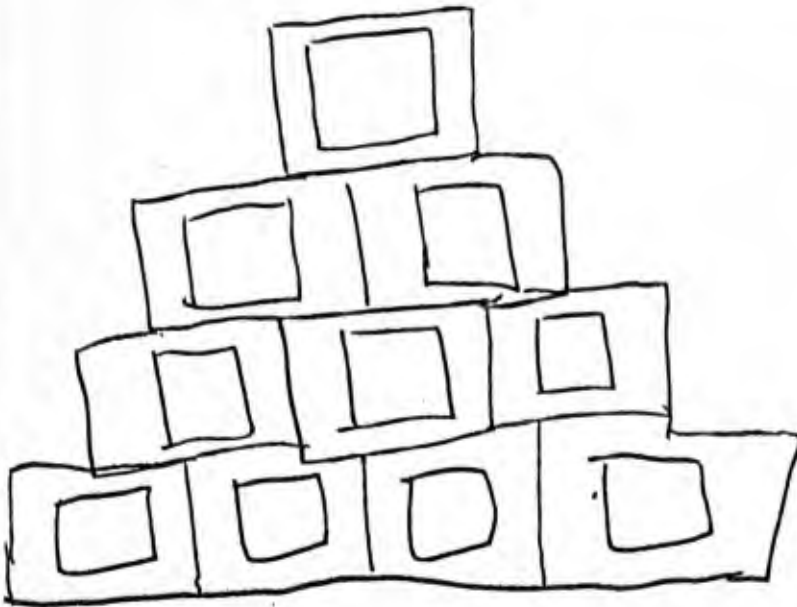
This subject stayed closely to the model retaining the essential rectangular shapes. he divided the building equally and in one sense correctly, but he used the set of circular windows twice. (a common error until about 11 years with this group of children.)

From the Identity Re-Construction Task (1) (item 3)



boy.11:6. attempt to get two buildings out of one. PLATE 35

this subject counts correctly and varies the circles with ease. however, he stayed closely to the model, halving it, counting and checking as he drew. he was unable to divide the building unequally.



"make this building into two buildings."

girl. 9:9.

This girl works correctly on a unit basis and is well able to re-structure this material. Generally, it was only at 12 years that Ss. in this sample worked with any ease on a unit basis. A number of Ss. in the 8 and 9 year old age band were still have difficulties over the actual division of the units.

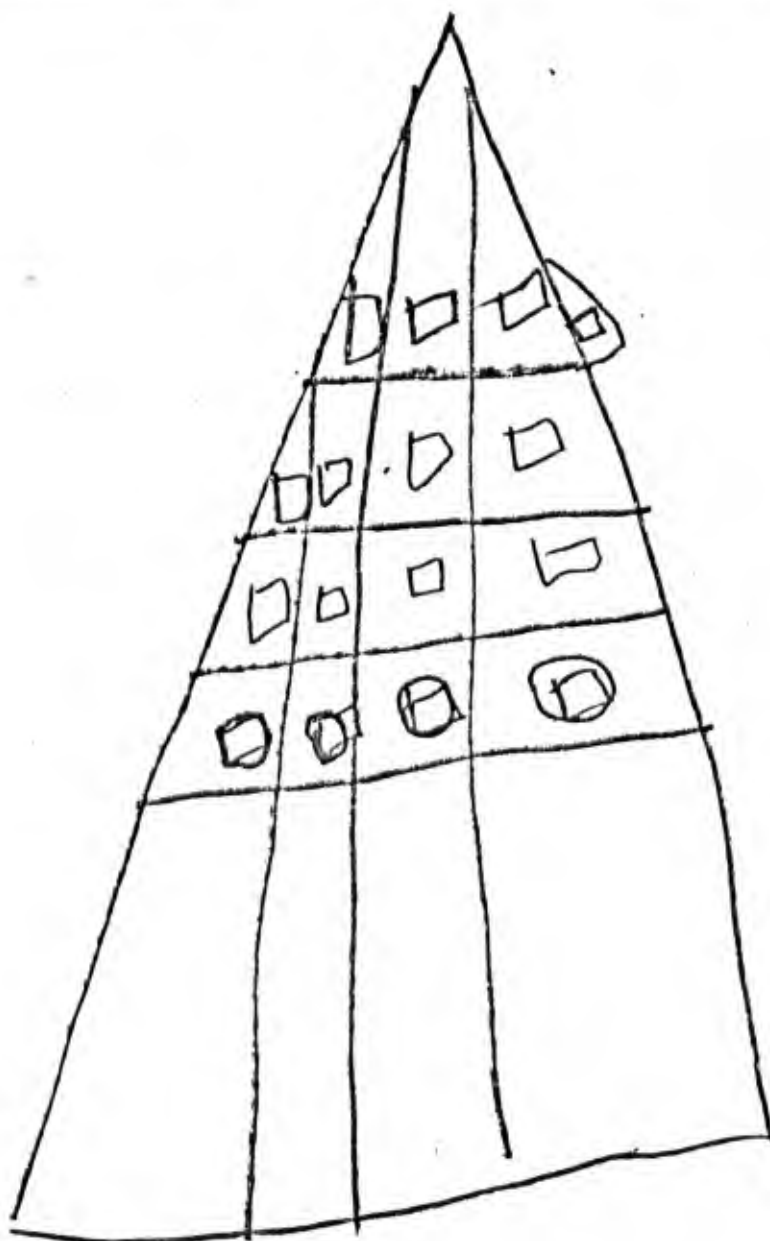
From the Identity Re-Construction Task (1). (Item 3.)

The third and final item of the Identity Re-construction Task obliged subjects to deal yet more radically with the structure of the building. This was clearly the most difficult task for at 13 years of age only half of the subjects could manage it, though all of the subjects in the same age group were able to divide the building correctly.

None of the 6 and 7 year olds gave any consideration to the units comprising the building as was evidenced by their approach. In general, for instance, they began by drawing the final outside shape into which they fitted the units - the bricks and the windows. In other words, the units were adapted to suit the new shape. They bore no relation to that shape.

Amongst the oldest age group - 12-13 years of age, it was evident that they still found it difficult to envisage what the final shape could look like. Unlike the youngest subjects, they were aware generally, that the units would determine the outcome and thus did not begin by drawing the final outline. However, even with this awareness, theirs was still very much a step by step approach. For example, subjects in this, the oldest age group, would draw, building unit upon unit (correctly), but then they would find themselves obliged to cross out a unit because they had not always grasped the implications of its position, or were short of units to complete what they thought might be a final outcome. An interesting example of this is given by a girl aged 10:10, who attempted to avoid this problem by distorting one unit (i.e. one brick) and making it into one large unit (PLATE 41).

With time and development, no doubt these subjects, in this oldest age group will become certain enough of structures, their composition and the relationships of component parts to handle them knowingly. New structures emerge from modifications of known structures, but unless modifications spring from understanding, however 'interesting' they may be, they cannot be regarded as true re-constructions, but must be seen rather as distortions of reality.



"change the shape of the building"

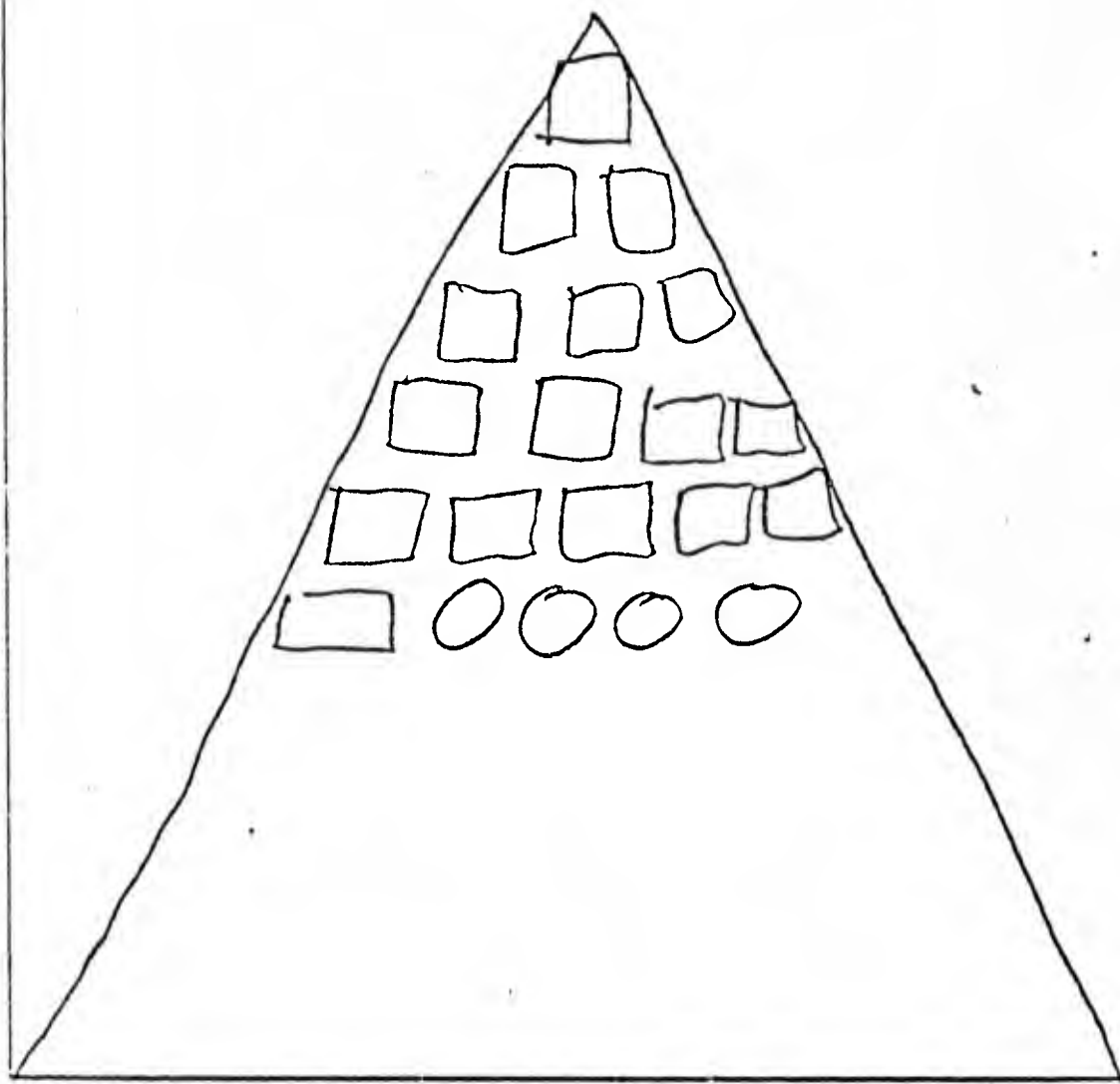
Boy. 6:4.

PLATE 37

Until 12 years of age Ss. in this sample still made errors regarding the relationship between the shape of the building and the units comprising the building.

When asked to change the shape this subject like most others in the 6 - 10 age band, immediately drew a triangle shape, then counted the units and put them in the triangle. He simply added a piece onto the side when he found he could not fit in a fourth window on the third floor.

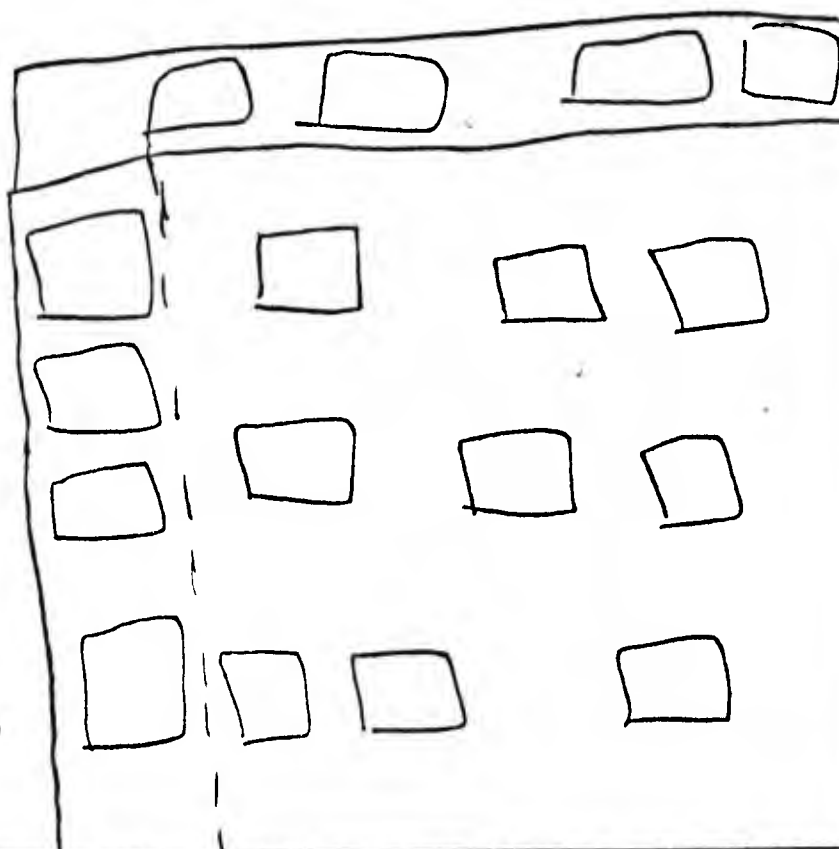
From the Identity Re-Construction Task(1). (Item 4)



Boy. 7:7. attempt to change shape of building.

PLATE 38

the above is an example of the most typical solution offered by the seven year old age group. by now, the third task, the subjects were generally more careful about counting the units and this boy has the correct number of squares and circles, but he is unable to relate the structure and re-structured attempt to the units themselves. He saw no conflict between his own attempt and that of the model.



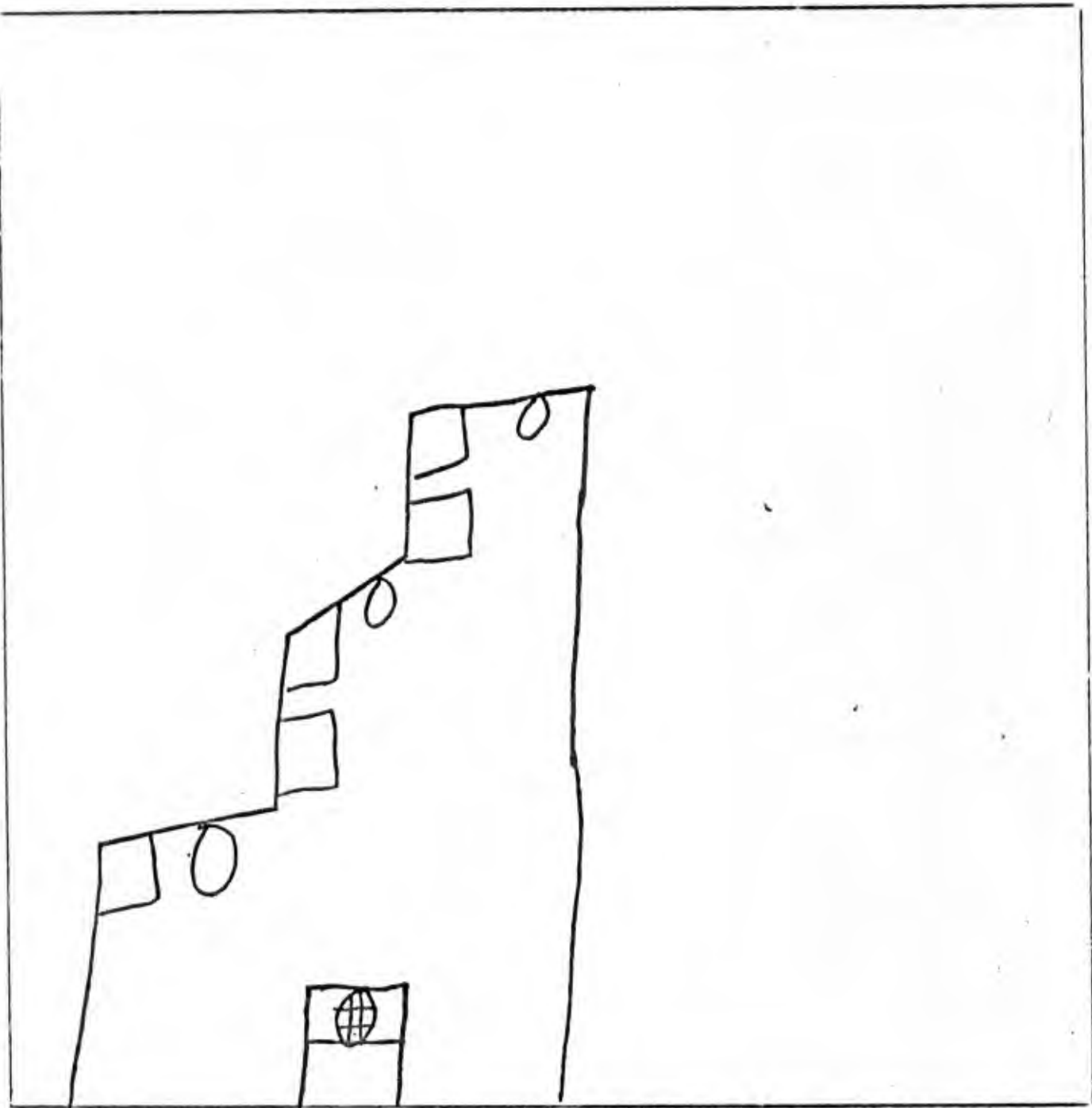
"change the shape of the building"

boy. 9:8.

PLATE 39

An attempt which reminds one of some of Piaget's findings in classical conservation tasks. This child tried to change the shape by adding a strip of four units down the left hand side of the building. This could have satisfied the requirement of the task, but he then confused himself by counting this strip as four units, then including this same strip in his counting of each floor of the building (i.e. counting 4 across from left to right instead of 3). He was certain that he had 20 units. He forgot about the circular windows.

From the Identity Re-Construction Task (1) (Item 3.)



"change the shape of the building"

boy.10:8.

PLATE 40

The most common error in this age group was that of not relating the units comprising the building to the shape of the building. In fact this error persisted significantly until the 12 yr. old group.

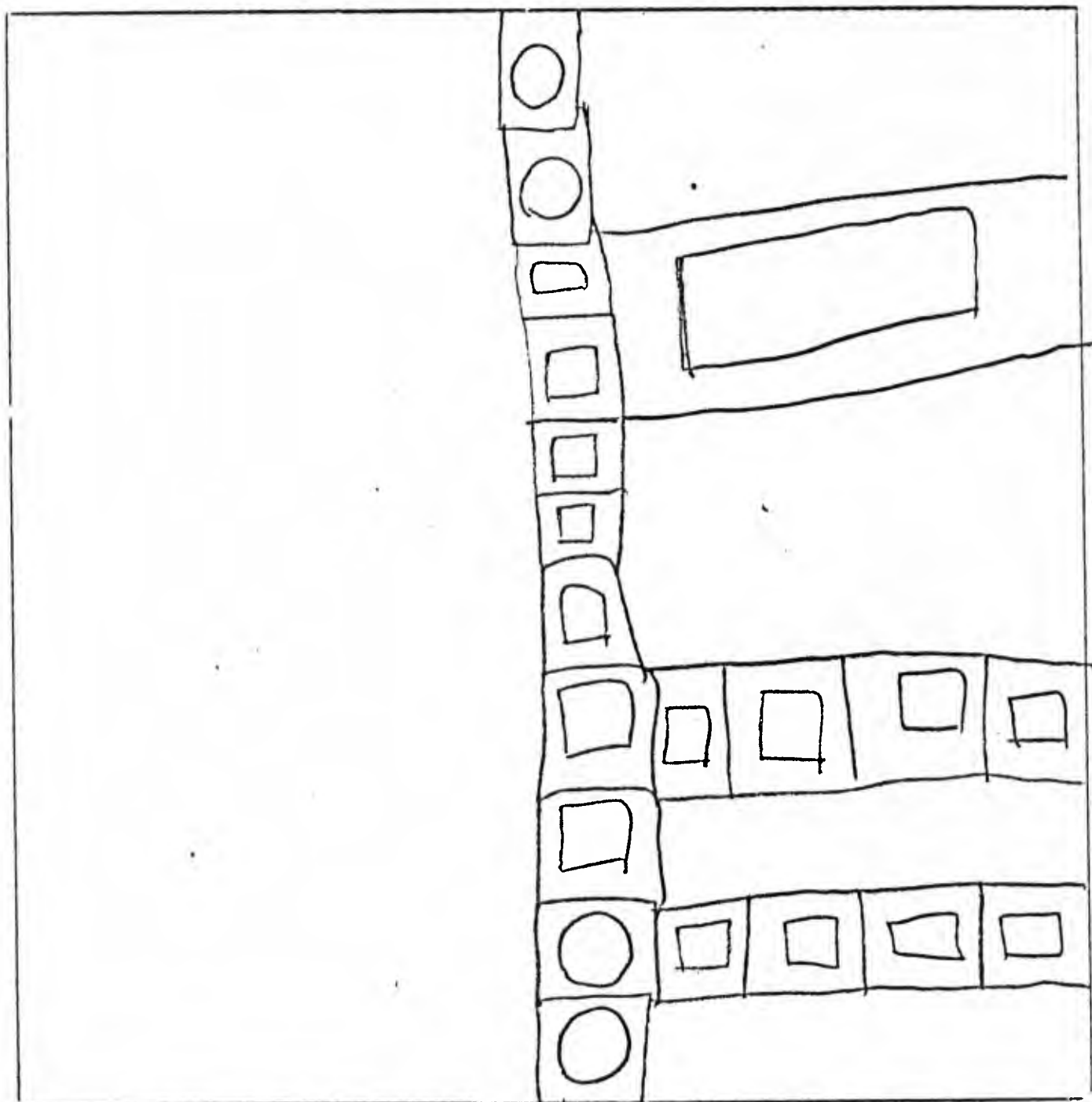


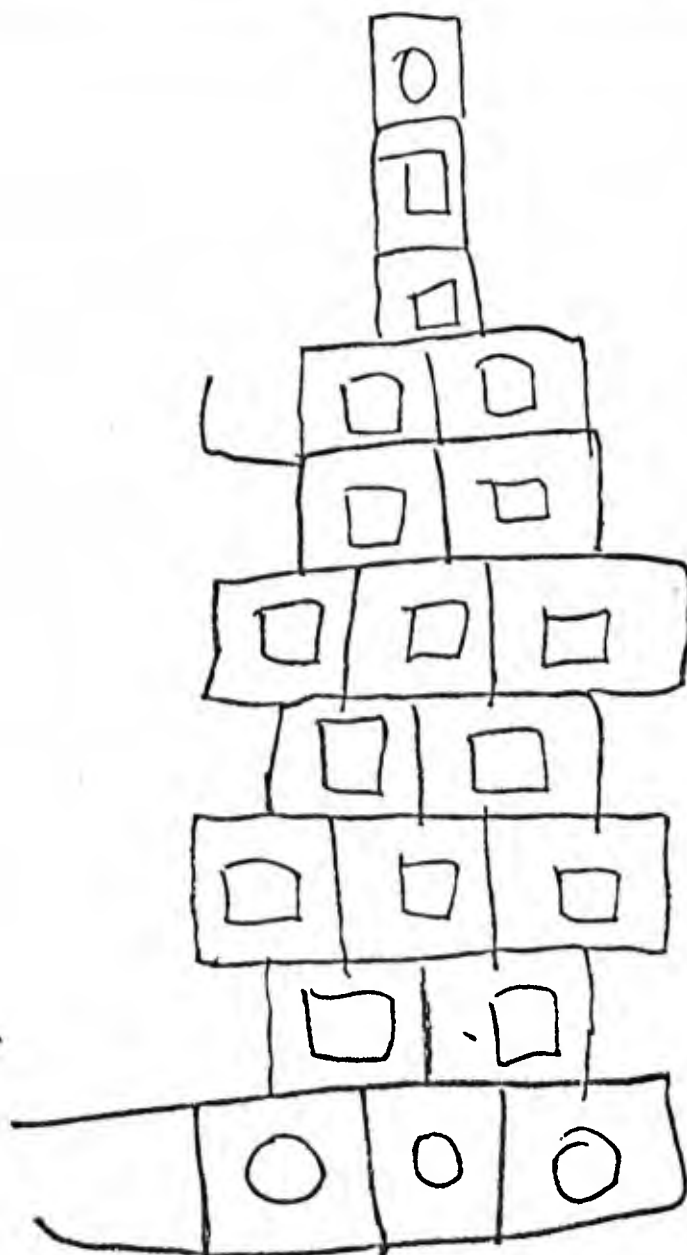
PLATE 41

girl. 10:10.

Only 4 Ss. in this age group managed to change the shape of the building correctly - relating the shape of the building to the units composing it.

This child grasped the notion of the units and the fact that they must determine the shape. However, she found it hard to envisage the final building. Although she counted carefully at the start, she recounted four times as she drew. Also, she was obliged to draw one large window (top right hand corner) in an attempt to fill out the space which she had miscalculated.

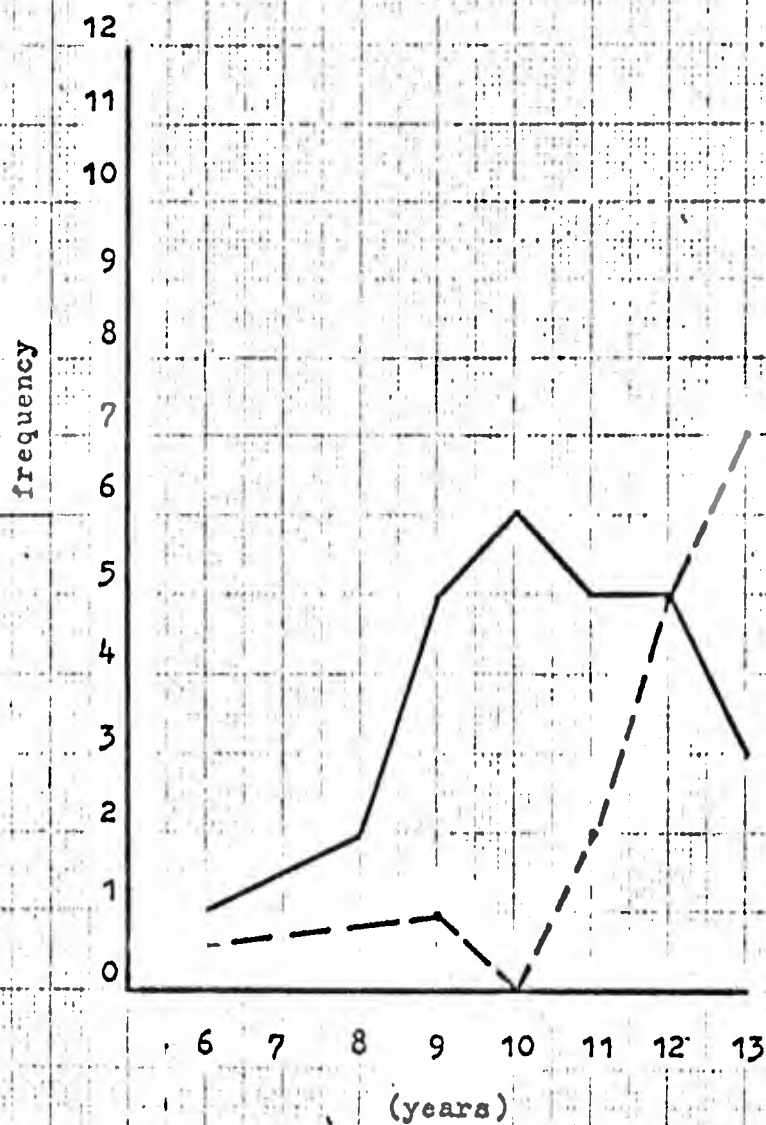
From: Identity Re-Construction Task. (Item 4)



boy. 11:5. a way of changing the shape of the building.

PLATE 42

this subject carried out the task correctly. he was well able to divide the building up into units and re-construct on a unit basis. he worked quite slowly and counted aloud as he drew the squares, stopping from time to time to re-check the number. only 5 subjects out of this age group were able to offer a solution on a unit basis. all other solutions were tied to the rectangular shape of the model.

A BREAKDOWN OF THE WHAT WOULD HAPPEN IF TASKBY AGE.

----- = an organised response.

————— = partly organised response.

WHAT WOULD HAPPEN IF TASK

The main purpose of these items was to see if the subjects could conceive of a hypothetical system of relations. There were two main questions:

"What would life be like if there were no such thing as night?"

"What would life be like if there were no such thing as talking, if men didn't speak?"

It was hoped to distinguish between ego-centric based phantasy and reality adjusted imagination, which is capable of creating new systems by adjustments to present ones.

Only at 12 years were a small number of subjects (6/12) fully capable of conceiving a hypothetical system, and of realising the inter-relatedness of a system and the idea of implication.

Within the 6 and 7 year old age group, 12/24 subjects confined their responses to the first task to personal reactions:

"It would be horrible, I wouldn't like it. You could play out all the time."
(girl 6:5)

"It would be very boring and dull, You couldn't sleep at night."
(boy 6:7)

Some of the responses in this 6-7 year old age group were comprised of a series of ideas or comments on the situation but for the most part the ideas were unrelated in terms of a system.

"I wouldn't like it very much. You couldn't play scary games. I would get under the bed and I would make it be night and then I'd play scary games that way. It would be sun all the time, no night."
(girl 6:7)

The above example suggests that the child might be aware of adjustments that society would or could make (getting under the bed to make it dark) but her ideas are essentially about her own immediate world. Apart from offering unrelated ideas, a number of subjects seemed to forget what the main change in the system was to be:

boy 7:6

"Lights wouldn't shine. You could play out all day. You wouldn't be able to go to sleep. You wouldn't have to shut the curtains because it's daytime. You would shut the curtains when it got dark."

(non-systematic)

Those offering ideas as opposed to personal reactions seemed unable to realise that one change in a system - such as the disappearance of night would lead to further changes and adaptations and new inventions. Most of the 6 and 7 year olds could only think of the idea as a loss to a system - the present one - which they know. They showed no real ability to go beyond this present system.

In the 8 and 9 year old group there was a drop in responses based on personal feeling (only 2/24 responded thus) and an increase in responses composed of related ideas (7/24), though only 1/24 put forward a response composing a hypothetical system in either of these tasks. There were, however, marked changes in the quality of the responses:

girl 9:11

"Well, all the people would be tired and their eyes would have all black lines. And the flowers wouldn't close ... you'd get tired. You'd never see the stars and the moon. People would have to work all the time and you'd never know which time it would be."

(partly systematic)

The above subject seems to be aware of events affected by night - i.e. stars and moon, the closing of flowers, etc. To this extent, she is aware of the inter-relation of events, but again she fails to make adjustments to the present system and so, instead of an alternative system, she thinks mainly in terms of 'loss' to the present one.

The second task revealed the same pattern of findings.

In the 10 and 11 year old group there was an increase in related ideas (13/24) with 2 subjects putting forward responses which were truly systematic in nature. The pattern of responses was very similar for both tasks throughout.

boy 11:6

"We'd all learn dumb language. We couldn't have pop-stars or ventriloquists because you wouldn't have the voice. It would be difficult to ask for fares on the bus and you wouldn't know ... the conductor wouldn't know where you're going."
(partly systematic)

Though there is some grasp of the implications, there is still the essential notion of 'loss' against the system known to him. The following example was the first systematic solution from this age group (from task 1):

girl 11:9

"Well most probably - if people had already known night presumably they would take a lot of the day to sleep in. It would be quite difficult to tell the time because it's not getting dark. You wouldn't be able to tell the time from the sun. If there was no night and no dark then I suppose the sun wouldn't go down - it would just have to stay in the middle somewhere - and it wouldn't rise in the morning because there wouldn't be one. We'd have to use watches a lot and I think we would have to invent a time centre so that if your watch broke someone in the world would still know what the right time was. We'd have a lot of shift working because you could work at any time, and everyone wouldn't sleep at the same time. It would be safer from robberies because there wouldn't be any dark time to do them. Most probably people wouldn't take it seriously if you stayed up all night because it wouldn't be the same thing."
(systematic)

In the 12 and 13 year old group there was an increase in the above type of response (13/24). There were no responses based on immediate personal reactions and only one composed of unrelated ideas.

boy 13:11

"A new method of communication would have to be developed. This could be by mime - very detailed kind of mime or by using the deaf and dumb language. High-speed typewriters might have to be invented so communication is easier. The world may not be such a developed place as it would take more time to get ideas going, from one person to another in different countries. It would be a much quieter place to live in and people might find it hard to put up with any kinds of noises."
(systematic)

Again this subject has the ability to go beyond the system he knows to a system which could be. It is felt that true creativity requires this ability. Creative transformations can be confined to the concrete: subjects can structure and re-structure reality in immediate ways - as, for

instance, with the matchstick problem, but full creative behaviour requires that individuals have the ability to go beyond what they know - not in a lawless phantastic manner, but in a creative, reality-adjusted manner. It would seem that this operation does not begin to be possible until about the age of 11 according to this sample.

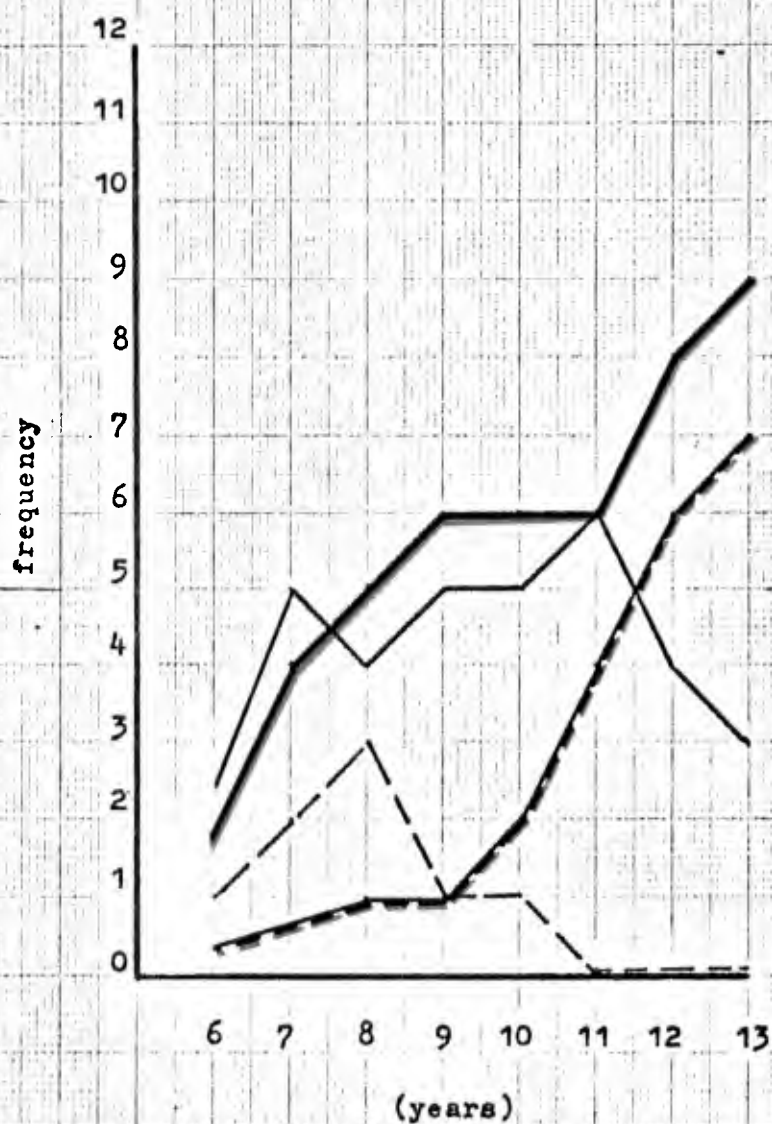
RE-CLASSIFICATION

The most important aspect of this task was the ability to understand classification and to seek out new criteria for new classifications. The kinds of criteria selected were also of interest - and to some extent, for reasons already given - the size of groupings and the number of groupings. Unlike classification tasks in standard IQ assessments, in this task the subject was not required to exhibit learnt knowledge of categories, but rather to show an understanding of categories by the formation of 'new' ones.

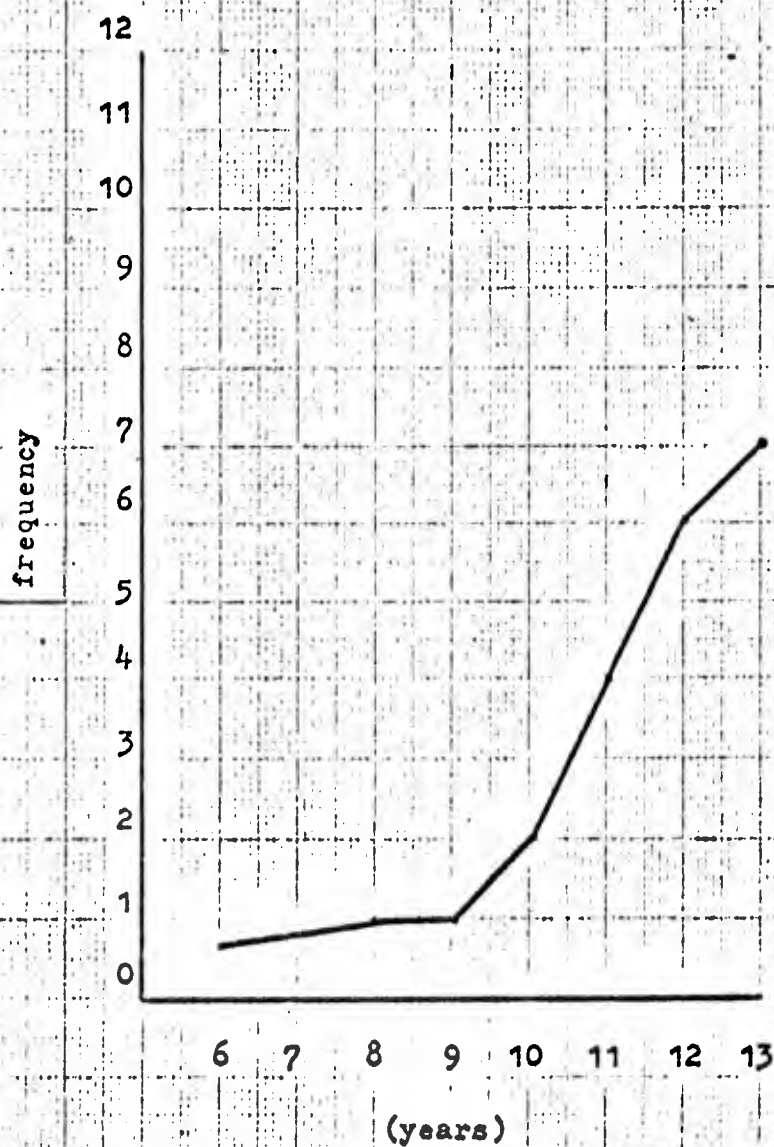
A number of the 6 year olds still had reading difficulties, in spite of the fact that the vocabulary employed in the tasks was checked with staff of the schools concerned and was regarded as being well within their competence. Because of the difficulties shown by this group, their results were not included. They would have resulted in a "no score" for this task.

In the 7 year old group, there was no overall score, but there was an improvement against the 6 year olds in the sub-categories. There were 4/12 subjects who employed genuine association as criteria, two of whom came very near to scoring on this task. This trend - i.e. the shift to use of associative criteria, instead of reliance on objective or shape-sound criteria - continued, and by 10 years half of the group were employ-

A BREAKDOWN OF THE RE-CLASSIFICATION TASK BY AGE.



- = objective criteria
- - - = shape/sound criteria.
- = association.
- = at least 5 groupings. minimum of 3 words to each grouping.

THE RE-CLASSIFICATION TASK BY AGE

*n.b. scores of 6 year old group were not included.

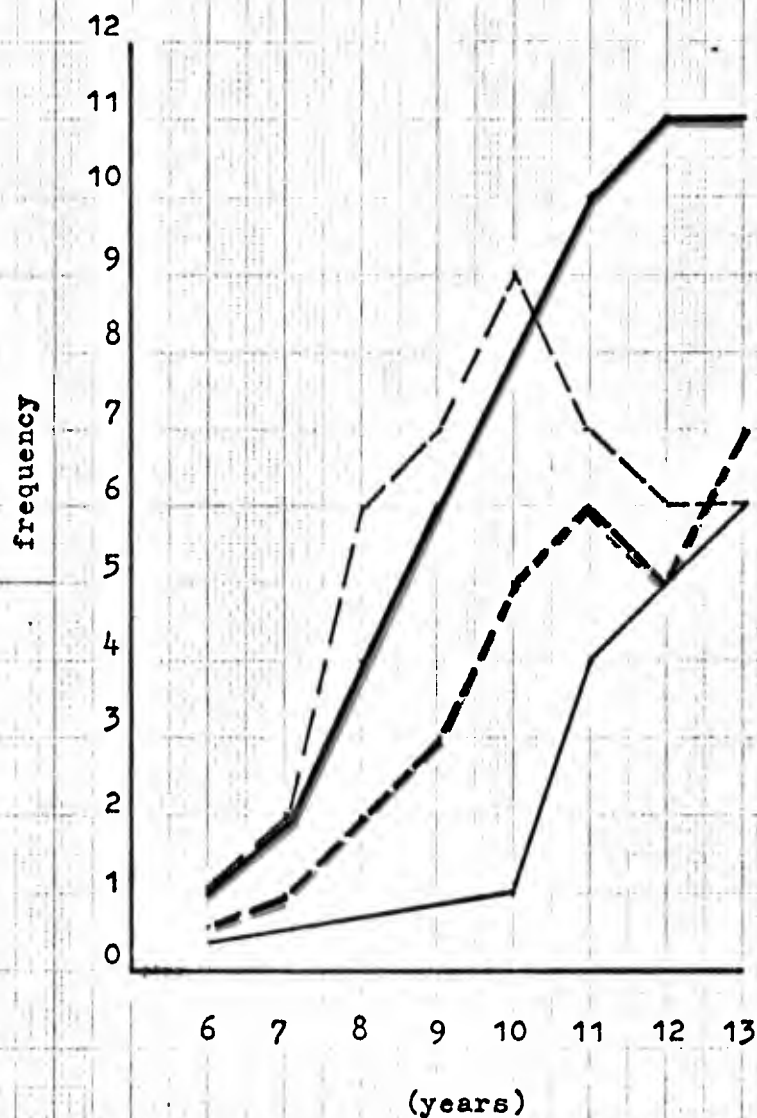
ing association, and whilst two subjects only scored on the overall task, there was an improvement on the sub-categories.

By 13 years, 9/12 of the subjects were using genuine association as criteria and no subject used shape-sound criteria. Further, 7/12 of this age group scored on all of the sub-categories, and thus on the total task, with three others very near to doing so.

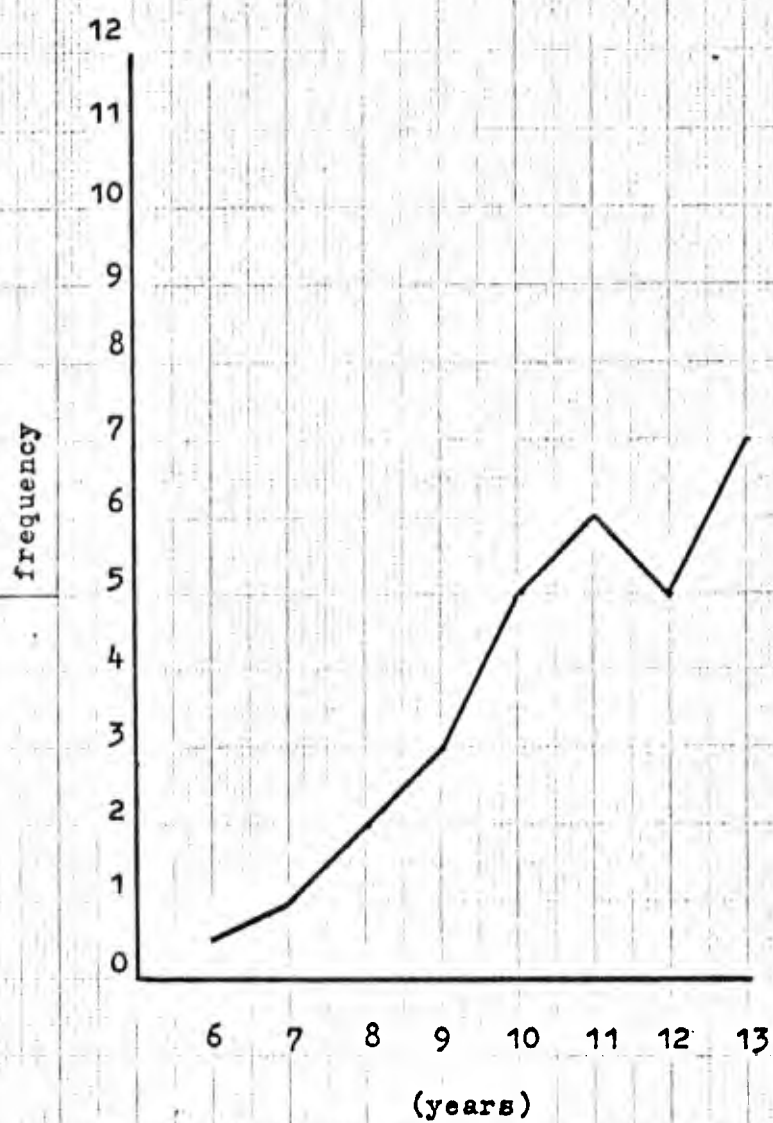
In the light of Entwisle's work it was thought that the younger subjects would form larger groupings of words, largely because they are less word socialised and produce looser associations. In fact, it was found instead that the youngest subjects produced the smallest groupings and that generally the size and number of groupings increased with age. However, it might be accurate to say that Entwisle employed a method which encouraged free associations by providing a word stimulus and requesting responses to it. In the method employed in this research both stimuli and the responses were in fact provided; the subjects were required to form some kind of relationship between the two. This is a more constraining and more determined type of task, as the subject had to search amongst already provided responses and justify his associations - not simply generate them. It is felt therefore that there might well be no contradiction between the two sets of findings.

A BREAKDOWN OF IDENTITY RE-CONSTRUCTION(2)

BY AGE.



- = an organised response (definition)
- - - - = a partly organised response (definition).
- = correct figural definition.
- . - . = constructive use of stimulus lines.

IDENTITY RE-CONSTRUCTION(2) TASK BY AGE.

IDENTITY RE-CONSTRUCTION (2)

In this second re-construction task there was an initial definition task, again to see how well individuals apprehended the structures, and, in a sense, the test was also an attempt to make subjects concentrate on the structure as preparation for re-structuring.

The trend here was very much the same as for Re-Construction (1), namely a decrease with age in ego-centric and disorganised descriptions and a movement towards organised descriptions with objective information.

The actual re-structuring task was somewhat different in nature for here the subject was free to decide the outcome, whereas in the first task he was somewhat restricted in terms of the relationship of the units to the building possibilities. However, in this task, subjects were still required to comprehend the essential structure of the objects concerned - this time a simple leaf and square - and comprehend them enough to be able to re-structure them.

Surprisingly, even the youngest subjects were able to understand the essential idea behind the task, namely that the components of the leaf and square were to be 'cut up' in some way and re-used to create a new structure or structures. Their efforts indicated their comprehension of this dimension. What did vary with development was the ability to adequately carry out this task, and eventually the ability to carry it out with ease and so really re-create.

A major difficulty of the 6 and 7 year old group was that of defining the pieces - as a result lines were re-used without subjects realising it. Size relations were altered greatly by 10/24 of the subjects of this age-group and 11/24 produced no real change in the basic shapes.

Some children used the structures on the card as a kind of 'inspiration' for a design or drawing. One child, for instance, drew a kind of spider's

PLATE 43

girl. 6:7.

To some extent the child here grasped the idea behind the task but was unable to be fully re-constructive in the use of the lines. However, she was able to identify the lines with accuracy which was surprising in that it was thought that Ss. of this age would find the task impossible.

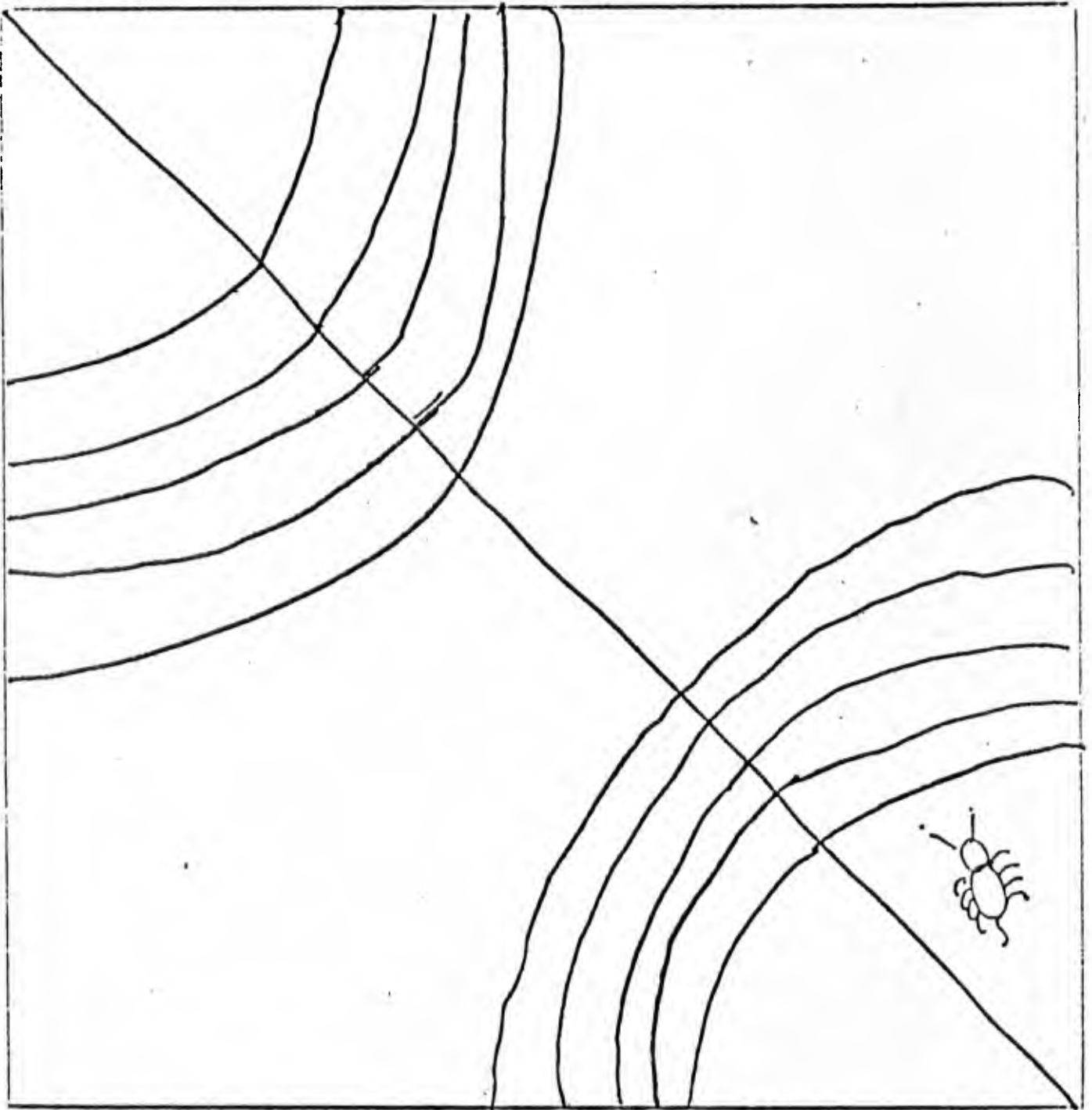
From: Reconstruction of Identity Task.2 (item 2)

PLATE 44

girl. 6:7.

This illustrates a very elementary grasp of the task of reconstruction here. The child understood the kind of change that was required but was unable to carry it out. Generally, the task was beyond this age group and the following group, but their attempts were surprising and more accurate in basic understanding than expected.

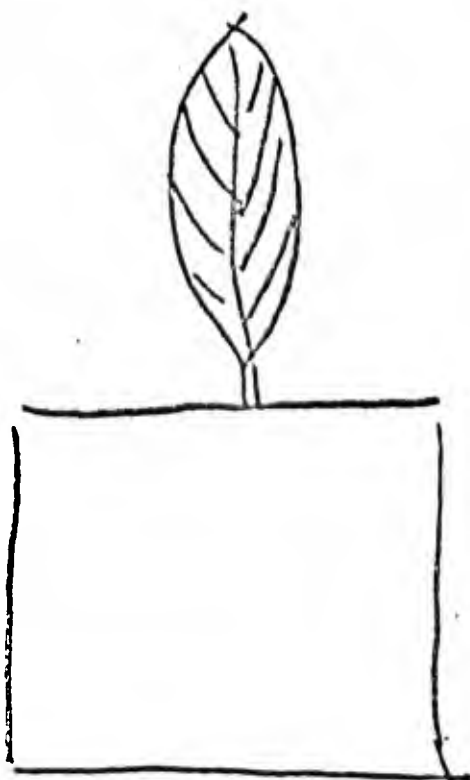
From: Identity Re-Construction Task 2 (item 2.)



girl. 7:7. attempt at re-structuring the leaf and square.

PLATE 45

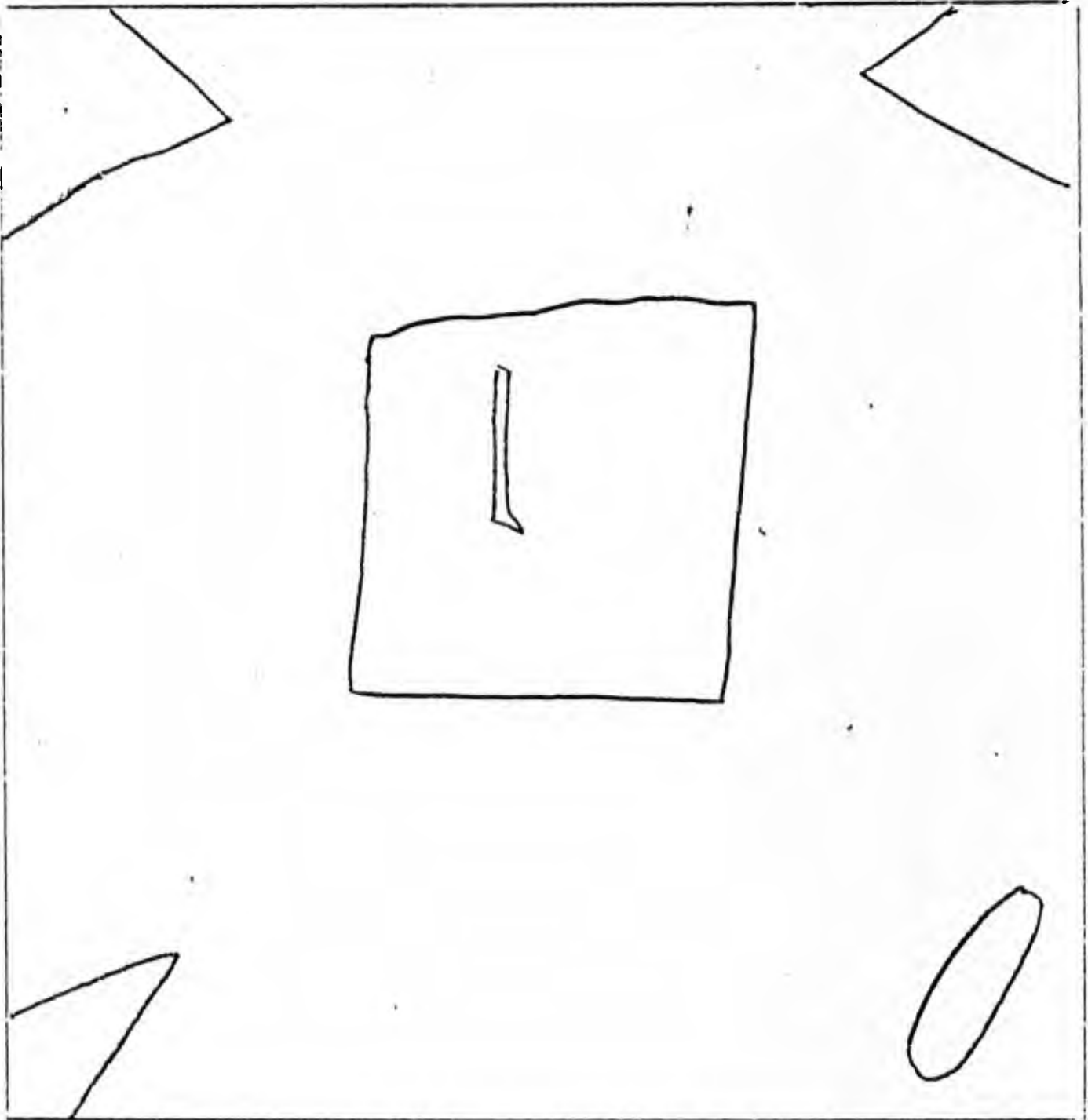
without doubt the child's attempt is 'inspired' or based upon the leaf and the square, but it is not an accurate re-construction of the parts of the leaf and square. It is perhaps an instance of the 'fantasy-based' type drawing of younger children, which can be confused with creative work.



boy. 7:4. an attempt at re-structuring the leaf & square.

PLATE 46

not only does this boy fail to make any radical change to the basic shapes, he adds extra veins to the leaf and alters the size relationship between the leaf and the square. when challenged on these issues, he saw no conflict between his efforts and the model.



girl. 7:6. attempt at re-structuring the leaf and square.

PLATE 47

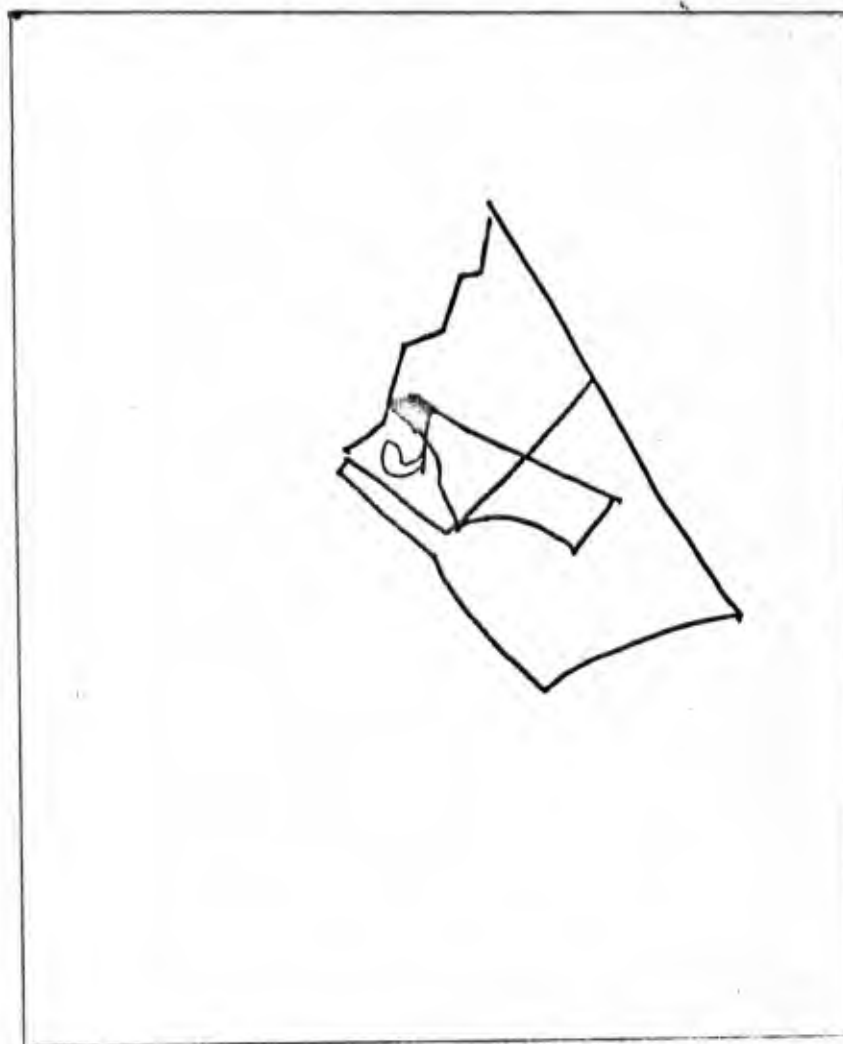
this is one of the more accurate attempts for this seven year old age group. the child has grasped the essential idea of the task. she has the correct number of pieces and she attempts a design. however the design is rather fragmented. she alters the size and shape of the leaf. she cleverly includes the central leaf vein in the square as part of a longer leaf stalk.

web based on the shape of the leaf and the veins (PLATE 45). She explained this as she went along. However she departed from the essential structures and finally added a spider to complete the attempt. Those children in this age group who were able to define the correct number of pieces (or almost so) still found it difficult to structure the pieces into another identity. They stayed very close to the model, touching the model then drawing a line, then another. This step by step approach prevented them from envisaging a final outcome and from embarking upon it, and instead they simply drew line after line adding to whatever form was being built up. Other responses in this age group involved not really changing the basic shapes at all but simply putting the leaf (sometimes wrongly drawn) inside the square or vice-versa, or putting the leaf on top of the box with the veins of the leaf around the outside of the box, etc. The most striking feature was their inability to anticipate in their re-structuring. As in the case of the matchstick re-structuring, they only knew what was coming about as they drew. This gave them no real control over the direction of the emerging pattern or design. This kind of immediate approach continued into the 10 year old age group.

By 10 years of age ability to envisage what could be in terms of re-structuring was coming into being for many of the subjects (8/12). It is interesting to note that this same age group had more problems with the first re-structuring problem (only 3/12 managed to change the shape of the building correctly and relate the shape-change to the units comprising the building). This no doubt relates to the fact that in this second task subjects were told to re-shape as they wished. Those subjects exhibiting foresight were able to define and re-define the structures accurately, (though not all did so verbally in the definition task) and further, to re-use them in a controlled way to build up a recognisable shape or well balanced pattern.

Generally, most subjects found this task to be less difficult than the first re-construction task - which led to the consideration - is there some kind of problem which they encountered which might be termed "shape conservation"? The re-construction involved in the second main task was freer in that there was no determining relationship between the units comprising the structures and the identity to be structure. Task 1 provided an interesting example of the problems involved when the child does not understand the structural constraints governing transformations of identities. In such instances, he is not able to truly re-create out of what is.

Briefly, then, here, as in the first re-construction task, there was an increase with age in ability to re-structure the identities. It was only at 11 years that subjects were beginning to re-structure with some measure of control and foresight.

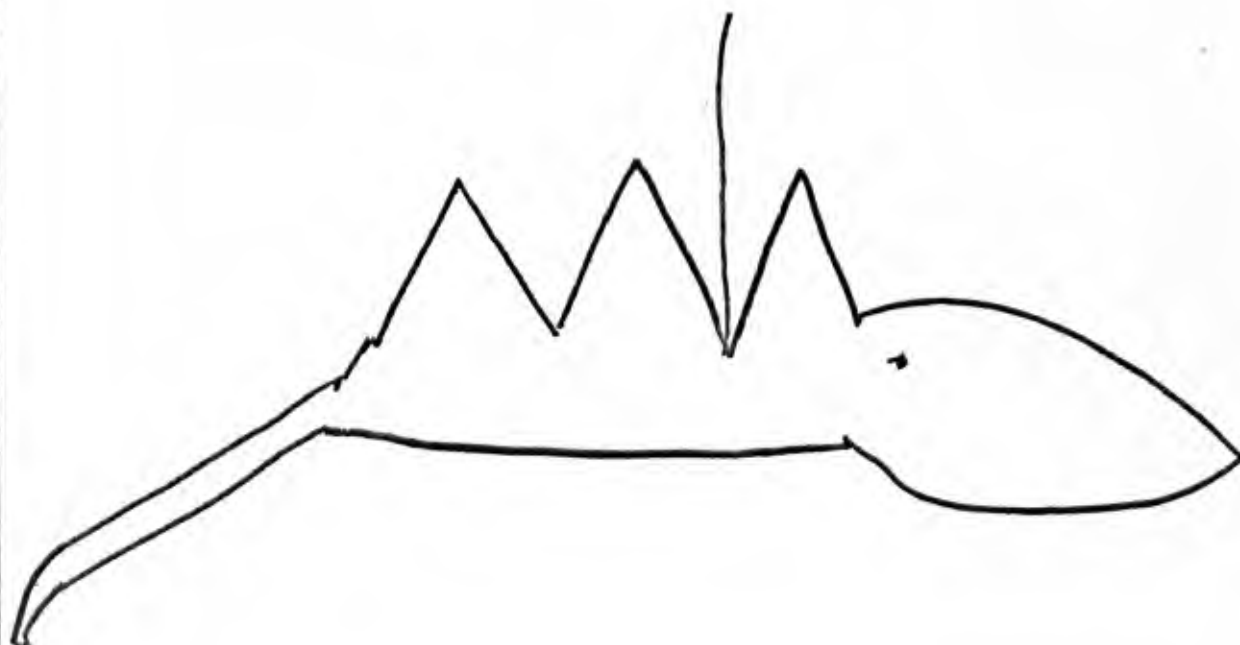


girl. 10:6. PLATE 48

This is a very typical attempt at the second Identity Reconstruction Task by a subject who appeared to grasp the essential idea behind the task but could not carry out the idea.

The girl here had a very step by step approach to breaking up the pieces of the leaf and square. She touched the model, measuring her own attempts against it. In a very distorted way (i.e. she changes size relations greatly) she almost manages to use the correct number of pieces in the above task. She was well able to describe her effort and aware of some of the errors.

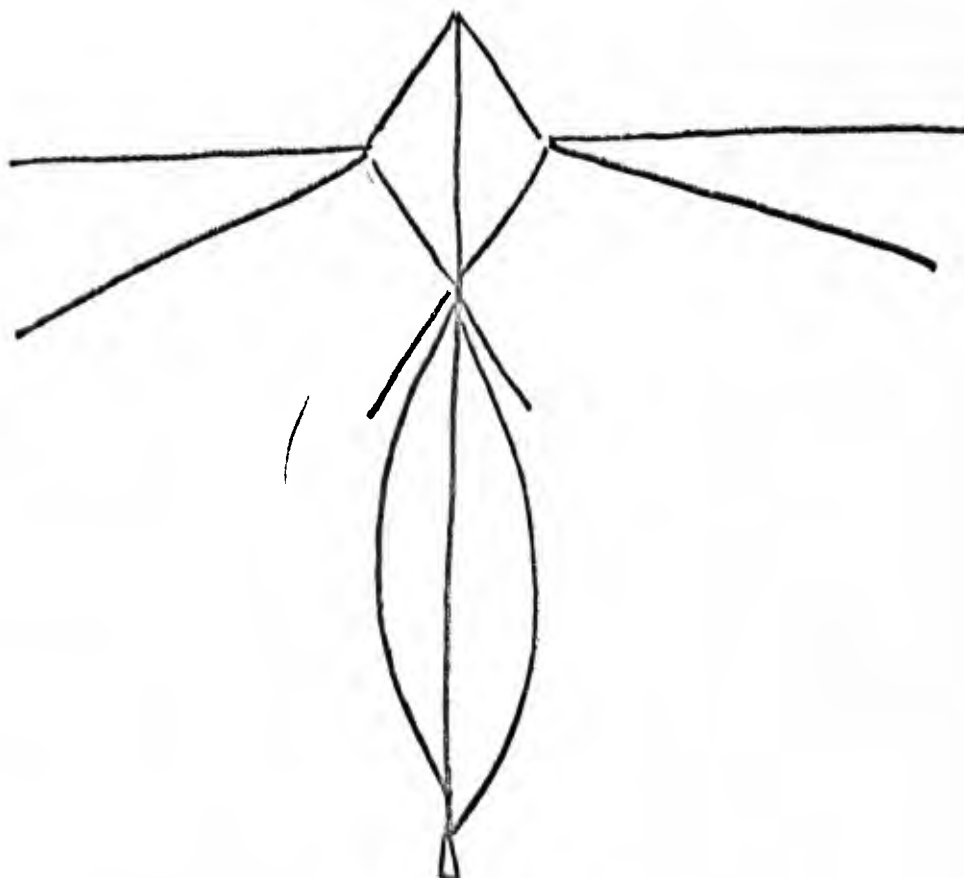
From the Identity Re-Construction Task.2 (2nd.item)

PLATE 49

girl. 9:11.

a very competent attempt at identity re-construction. this girl maintains reasonable size-relations and forgets only one part. she labels it: "a kind of fish". she clearly understands the task and is capable of transforming the objects.

From the Identity-Re-Construction Task (2) (Item 2)



girl.10:5. PLATE 50

This child grasps and is able to carry out the Identity Reconstruction Task(2). She called her re-construction: "some kind of insect"

As well as grasping the idea and using the correct number of pieces she maintains good size relations on the whole and is able to produce a well balanced product. There was great variation in terms of ability to carry out this task in this age-group.

Interestingly, this same subject had difficulty with earlier reconstruction tasks (1)



boy 11:6. a design out of the leaf and square properties. PLATE 51

correct use of all the pieces (except for stalk of leaf which he forgets) this is one of the most competent efforts for the eleven years old age group.

Chapter 7

ANALYSIS AND INTERPRETATION

This section examines the findings in relation to the underlying theory.

In the light of the statistical analysis, the coherence of the battery of tasks is considered, changes in performance with age and sex are discussed, and the possibility of a stage-explanation of creativity is raised.

Essential to this whole discussion is the idea of an operation. In the initial chapters, the implications of operations for creativity were brought out.

"....an operation is... the essence of knowledge; it is an interiorised action which modifies the object of knowledge."

(Piaget, 1972)

Implicit in the discussion continued by Piaget, and of course explicit in his theory and findings, is the notion that without a certain degree of cognitive organisation operational activity is not possible, and so ways of knowing, which involve transforming reality, are more limited. The wholeness of an operational act allows it to be reversed, to be repeated, to be adjusted, to be returned to its original state. In other words, it involves levels of reflection and allows, in varying degrees (concrete to formal), the acting individual to objectify the phenomenon and his action upon the phenomenon. At its peak, this level of reflection finds completion in formal operational ability.

In the matchstick task, the effects of this ability were apparent. 6, 7 and 8 year olds subject (as well as a few individuals in older age groups) structured and re-structured in a non-systematic way. Each solution was very much a new discovery and gave little help towards the generation of another. Older subjects, by contrast, clearly generated what might be termed 'mental models' (see figure over the page). They structured and re-structured by means of adjustment to a model, and only when they sought a new model did they revert to concrete explorations with the matchsticks. They showed ability to know an action, to know what its possible modifications could therefore be, and further, they

Piaget, J. (1972) "Development and learning" in: Readings in Child Behaviour & Development. Iavatelli C. & Stendler.F (Eds). P.38.

SYSTEMATIC PROBLEM SOLVING (RE-STRUCTURING)



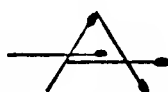
a.



b.



c.



d.



e.



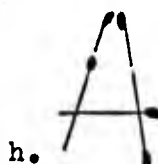
f.

the above sequence of attempts by a girl 12:10 illustrates a gradual adjustment of a basic model. the subject clearly knew the basic structure of the model and worked from b. to f. inclusive without any concrete experimentation with the matchsticks, apart from making the necessary adjustment.

Having exhausted most of the possibilities of the above basic model, she then explored more with the matchsticks to find another basic model, and then continued with further solutions without further experimentation.



g.



h.

for this second series the matchsticks were broken.

not all Ss. in this age group responded this way. in general though younger Ss. did not apply this approach. each solution, in their case, was a thoroughly new discovery.

had broken away from the step by step approach which Piaget (1950) associates with pre-operational forms of thought:

"Thought alone breaks away from these short distances and physical pathways." (P.120)

This level of reflecting is crucial to creative re-structuring for it enables an individual to envisage what "could be" out of "what is". However, it takes place at two levels of functioning - namely concrete explorations or abstract constructions or imagining. Concrete explorations make possible some creative output - or at least could make it possible. As an exploratory process concrete exploration could be said to be an ingredient of creative behaviour - but it is a limited process because it is about the immediate, and one can only know the conclusions after concrete exploration; mental anticipation of what might be or could be is never fully possible at this stage. At different developmental stages, therefore, with creative behaviour, as with other dimensions of intelligent behaviour, there are qualitative differences in terms of the operations performed.

Whilst the matchstick task allowed for concrete exploration, but yielded a different level of performance from those capable of constructing "mental models", tasks in the Identity Re-construction Tasks (1) and (2) forced subjects increasingly to come to terms with the structure of the phenomenon in question, and allowed very little opportunity for concrete exploration. A grasp of the identity in this task involved a realisation that the building could be seen as being made up of 20 blocks, each block with a window. With this understanding, all types of re-construction became possible. However, many of the younger subjects only 'knew' the building as a rectangle. They failed to comprehend the relationship -

even realise it - of the units comprising the building to the total shape. Of those who did comprehend this relationship, not all were able to work on it. There are illustrations of efforts where children, working on a unit basis, could clearly not envisage what the final shape of their building could be. As a result, in one instance, one block was enlarged by at least twice its size to fill the 'gap'. A grasp of identity is not therefore an instant process for it involves a learning to 'use' the understanding one has attained. This is no doubt what Piaget means when he points out repeatedly that structures take time to 'settle down'. Similarly, this is why subjects in the settling period appear to offer inconsistent responses at different levels - sometimes appearing to grasp the issue - at others losing sight of the logic governing it.

So far, it would seem, on this sample, that re-constructions, seen as one type of creative process, are not wholly or formally possible until roughly 12 years of age - or in stage terms, until an individual comes to terms with formal operations. Concrete re-structurings, whilst an earlier possibility, are limited. Such re-structuring tasks essentially touch upon the same problems as the classical conservation tasks. Both are about conservation in different media. Both require that the subjects comprehend the essential identity and logic of the phenomenon and 'know' it well enough to be able to recognise it under changed constructions. Further, it might involve knowing the 'limits' to be placed upon re-constructions in order to maintain the initial identity, e.g. the components parts of a cupboard might be re-organised to constitute a desk - but this comes into the area of cultural labelling and identity boundary and involves learning, further, it is a less radical level of 'knowing' phenomena.

In the bottle top problem subjects were asked to structure rather than re-structure, further they were required to set their own limits - which were really those of practical usefulness and an invention related to the task - namely the removal of the bottle top. Here again, there was no real opportunity for concrete exploration. The subject was required to structure a whole identity in relation to another identity, be aware of its wholeness and the effects of one part upon another. Piaget has illustrated the problems of causal understanding in younger children (Piaget and Inhelder, 1973) and it was clear from solutions to the bottle top problem that young children were unable to 'know' the whole identity of their own invention, and the implications of its separate parts. In fact, again they tended to be somewhat syncretic (Flavell, see note *) in approach, conjuring up the whole in a vast impressionistic way, just as they conjured up a whole change of building shape without reference to the separate parts which defined and determined its shape. It is only with the advent of formal operational thinking that such structuring, believed to be an aspect of creative behaviour, becomes possible.

The What Would Happen If Task required a slightly different type of structuring. It was in fact a form of re-structuring which required the subject to envisage present systems with stated adaptations. Essentially, therefore, the task was about adapting structures. Again

Note *: (Flavell) "Syncretism.... describes a type of thinking or perception which assimilates reality into global, undifferentiated schemas; the individual contents of the assimilated reality interpenetrate and fuse with one another, anything being joined to or combined with anything else... (Piaget 1928)" P.273.

Piaget, J. and Inhelder, B. (1973) Memory and Intelligence. pp 199-211.
 Flavell, J.H. (1963) The Developmental Psychology of Jean Piaget. P.273.

the task allowed for no concrete experimentation, and again it was evident that formal operation structures were required for such adaptations to a system. Younger subjects found it hard to move beyond responses based on immediate, personal and concrete remarks. Further, none of them saw the implications of proposed changes to the structure - e.g. of the absence of night or of speech. It was only by 11, 12 or 13 years that subjects were able to envisage a system as an integrated and inter-related whole, and realise the implications of inter-relatedness and of adjustments to such.

Similarly, in tasks such as Elaboration Task which were really concerned with addition to and development of an identity, and the Recognition Task which involved apprehension and definition, the matter of operational ability proved crucial. Both of these tasks illustrated the qualitative differences between the responses of subjects still bound to a step by step approach in elaborating and identifying, and those, freed by thought and mental anticipation who could envisage the outcome and make further mental explorations before embarking on the task.

This necessarily leads into the question of imagination, and to the whole idea of structuring and re-structuring in concrete and abstract ways.

The formal operational thinker is capable of "delighting especially what is not..." (Piaget, 1950). Much confusion centres around the area termed 'creativity' often, as mentioned earlier, because no real distinction is made between phantasy and reality adjusted constructions or

inventions. Piaget believes firmly that the young child is not capable of imagination (Piaget, 1951). In some of the tasks set in this research, younger subjects illustrated their ability to indulge in phantasy-like responses, moving into worlds of their own, uncontrolled by actual situations or the necessary implications of their suggestions (PLATE 52). Even in Re-construction Tasks where factual information was required - in the case of definition, until 10 or 11 years, a small number of subjects (decreasing with age) added information of an ego-centric and phantasy based type, e.g. they offered (as already recorded) descriptions of people looking out of windows, dogs, etc, which did not exist, but were clearly 'real to the child'. This type of fluency is limited and non-productive. It is concerned not with the creative potential of phenomena but with distortions and the impossible. Such a phantasy base is not generally the breeding ground of ideas. It is this inability to imagine - to develop mental constructs of what could be, which distinguishes the formal operational solution from those tied by immediacy. Imagination has been confused with phantasy (Griffiths, 1945) and without doubt the same mistake has been made by Mearns (1931) and Torrance (1973) when they describe a fall in creativity around the age of concrete operational thinking and then a revival later, after what they believe to be an initial period of creative activity during the first three grades or so. This present research would explain the curve in terms of (1) phantasy, (2) operational growth and a subsequent reduction in phantasy, and finally (3) the growth of constructive imagination (PLATE 53).

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- Piaget, J. (1951) Play Dream and Imitation in Childhood. P.30.
 Griffiths, R. (1945) A Study of Imagination in Early Childhood.
 Mearns, (1931) The Creative Adult.
 Torrance, E.P. (1973) The Torrance Tests of Creative Thinking.

PHANTASY VERSUS CONSTRUCTIVE IMAGINATION.

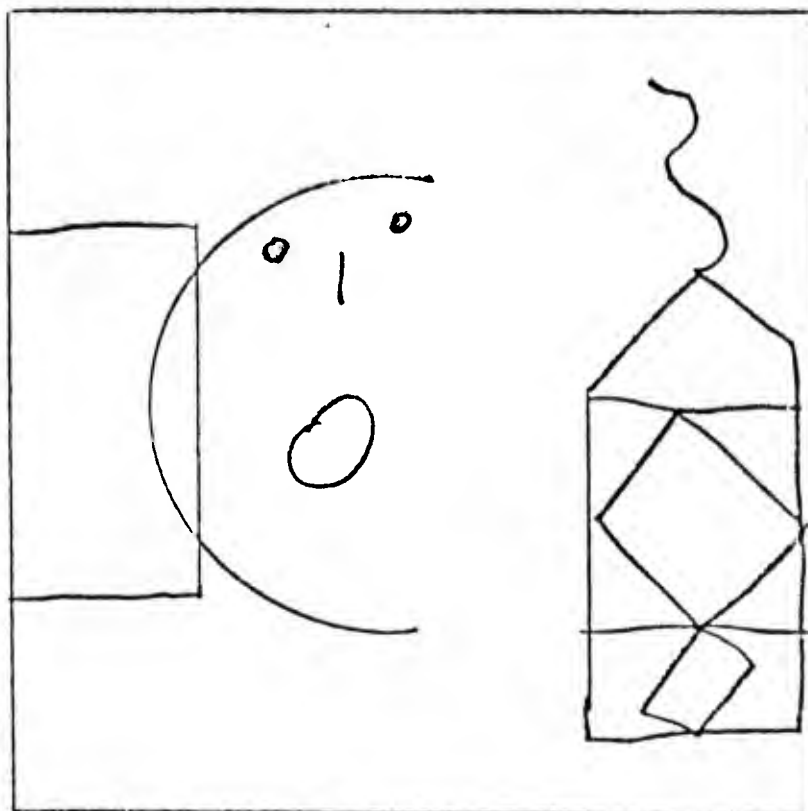


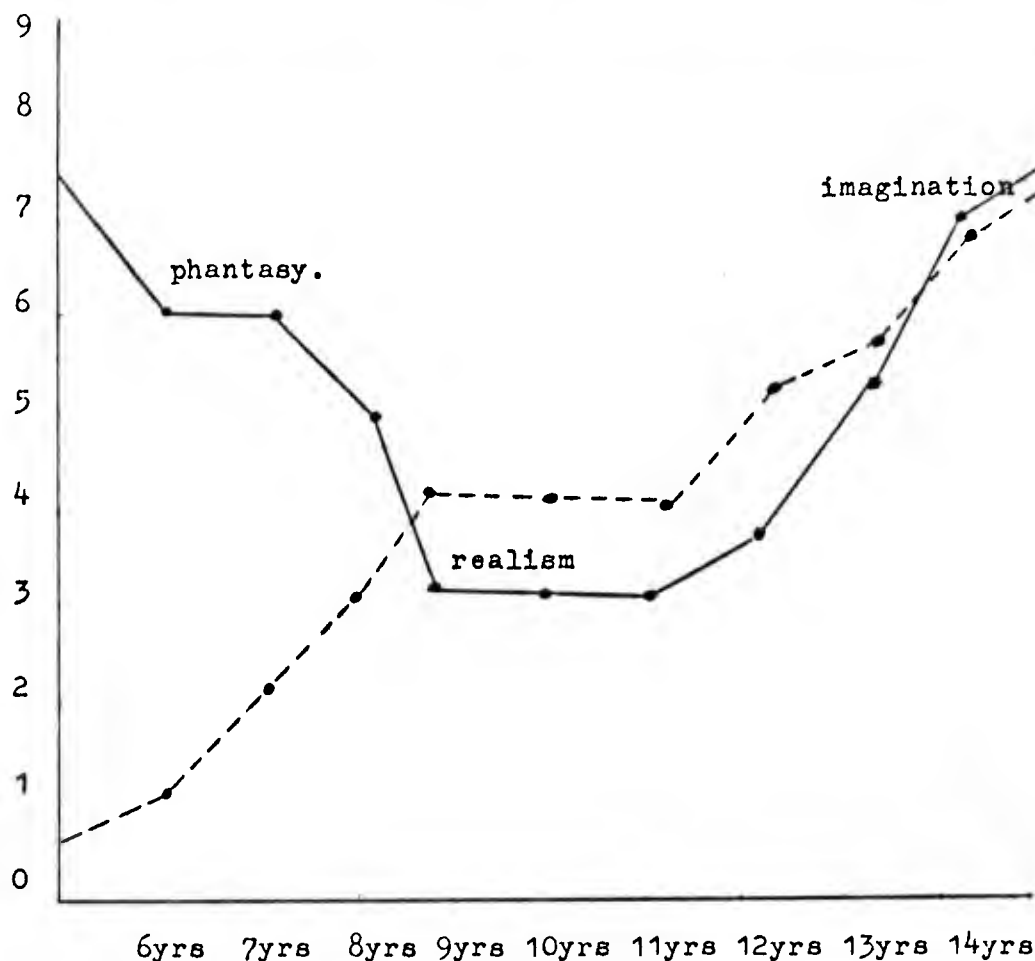
PLATE 52.

girl. 7:6.

The above drawing was accompanied by a story which was told slowly as the drawing was carried out. It is about the house the moon goes into. He is just about to go into his house when he sees a strange house so he has a very surprised look on his face. The second attempt was about a monster which arrived to eat the moon's house. This type of response is rooted in phantasy and not constructive imagination. However, were the response to be scored for statistical uniqueness in terms of ideas and amount of detail, this subject would have received a high rating for her age group.

From: the Elaboration Task (item 4)

HYPOTHETICAL CURVES OF PHANTASY & IMAGINATION WITH ABILITY



———— = the nature of responses.

----- = the development of operational ability.

Whilst the above is very much a hypothetical curve from present observations and assessments it is believed that the relationship between the development of constructive imagination and operational ability must approximate closely to the above.

In terms of training and fluency it has important implications, for both training and fluency must rest on certain levels of developmental ability.

Imagination is not concerned with some underworld of ego-defined realities. It enables individuals to envisage at the level of mental constructs what other younger individuals must experience in concrete translations. Imagination is an integral part of intellectual development. In terms of both convergent and divergent structures it enables one to move beyond the immediate. Freud spoke of the creative person as being one who is able to: "accept freely rising ideas" (1938) - this type of freedom is vital and related to notions of training and fluency - but the source of such ideas is equally important too.

The kind of knowing of which Piaget (1972) speaks and which is required for re-construction and creative re-construction must derive from formal operational abilities, involving imaginative constructs:

"... knowledge is not drawn from the objects but it is drawn by the actions effected upon the objects."

The construction and re-construction tasks were about this type of knowledge. They required the ability to build up mental constructs not only of what could be, but of self effecting the process. For unless one can objectify oneself, one cannot appreciate the role played by the self in the transformation of phenomena, and as a consequence, cannot understand fully that same transformation. Formal operational thought brings about a control, a smoothness in transformations of a type not encountered in this sample in subjects younger than about 11 years of age.

Operational inadequacy is a consequence of general immaturity of cognitive structures in younger subjects, and aspects of this immaturity revealed itself in other dimensions of the tasks put to these subjects.

Freud, S. (1938) The Basic Writings of Sigmund Freud, tr. and ed. by A.A. Brill.

Piaget, J. (1972) "Development and learning", in: Readings in Child Behaviour & Development. Lavatelli C. & Stendler, F. (Eds) P.41.

Varied research in the area of perception has underlined the perceptual distortions which affect children (e.g. Bryant, 1974). In the Elaboration Task, it was only by 10 years that a least half of the subjects in that age group were able to produce elaborations from different angles and including figure-ground variations. Prior to this point, their responses tended to be immediate - "V" shapes became beaks or just triangles, and they were generally perceived as 'figure'. More complex perceptions of the stimulus lines leading to 'remote' relationships between the stimulus lines and the elaboration only really developed in the 12 year old group in this sample. In the Identity Recognition Task, there seemed to be an inability to sustain what might be termed a "perceptual search" for complex outlines and forms before about 9 years of age (when 9/12 subjects used more than 1/3 of the stimulus lines). In the organisation of forms in space there was a marked increase with age. In the second Re-construction task for instance, it was only at 12 years of age that subjects made verbal reference to the position of forms in space and to size relations. It was in fact anticipated that such references would have been made much earlier - perhaps around 10 or 11 years.

Generally, it is perhaps accurate to say that Piaget has used language in his studies of children to come to a closer understanding of thought organisation, rather than make a study of language itself. However, his categories of ego-centric speech and socialised speech are applicable to certain findings here. Ego-centric speech is seen as lacking communication as its main aim and thus lacks adaptation to the listener. The world is described very much from the speaker's standpoint. Socialised speech on the other hand is concerned to communicate and thus to include other perspectives. In both re-construction tasks subjects were required to

"... children's definitions are interesting, but they are not easy to interpret, for all definition is conscious realisation." (Piaget, 1928)

A double problem exists therefore - a lack of conscious realisation for younger subjects, and the task of adapting what is realised to the standpoint of the listener. Ego-centric and unrelated information persisted in definition tasks until 9 years in the first Re-Construction task and 10 years in the second. By about 8 years at least half of the subjects were making verbal attempts to organise their information and some attempt to adapt it to the listener.

As described in earlier chapters Entwisle (1966), using an association method, noted that the younger the child the more the associations produced. This was explained in terms of a lack of language socialisation, and work such as that of Berko (1958) support the general idea. The findings here support the notion. Unlike Entwisle's subjects, here children's groupings tended to increase with age, but the task here was essentially concerned with relating words to one another - not with freely generated associates. It is true that because children have fewer markers than adults they tend to have broader classes and therefore larger groupings in some test situations; it is equally true that their inexperience with words and their associations makes it difficult for them to relate, or group together, associations which are not of their own free choosing. Interestingly too, as further support, there was an increase with age in the use of association as a criterion and a drop in rather 'arbitrary' links by means of stories "stretched" to include words which did not always easily associate.

Piaget, J. (1928) Judgement and Reasoning in the Child. P.114

Entwisle, D. (1966) Word Associations of Young Children.

Berko, J. (1958) "The child's learning of English morphology", Word, 14, pp 150-77.

These types of associations lead back into concepts such as "assimilation" and "syncretism". In all re-construction tasks, assimilation to varying developmental frameworks was noticeable. For instance, younger subjects missed out parts of the structures, altered them in some way, or imposed structures on units which were inappropriate, and vice versa. In the Bottle Top Problem and the What Would Happen If Tests, there was much evidence of what Flavell terms:

"anything being joined to or combined with anything else..."
(syncretism)

- systems were offered which could only be described as a series of non-sense relations.

Essentially what is under discussion from different angles, is the notion of the organisation of thought. Depending upon philosophies and research interests, the abilities of children have been investigated from several standpoints, but the total picture is one which incorporates several inter-related abilities (often separated for research convenience) which eventually become sufficiently stable, both as separate abilities and in their inter-relating, to be regarded as a form or organisation. This organisation, brought about by interaction and adaptation - is essentially what intelligence is about. It includes creative dimensions. This discussion believes that it is false to distinguish between creative and other abilities. This is supported by Cropley (1966 and 1968). Everything, of course, depends on what creativity is thought to be. Here, in the findings in general, it is clear that the ability to structure and re-structure reality is one which increases with age and with the accompanying development of cognitive structures. It is admitted though, that given different starting points very different conclusions about the

Flavell, J. (1974) The Developmental Psychology of Jean Piaget. P.273.

Cropley, A.J. (1966) "Creativity and intelligence", Br.J. Ed.Psy. 36 pp 197-201.

Cropley, A.J. (1968) "A note on the Wallach & Kogan tests of creativity", Br.J. Ed.Psy. 38, pp 197-201.

"creative abilities" of young children might be arrived at, as indeed they have been.

STATISTICAL ANALYSIS AND INTERPRETATION

David Lykken (1968) in an examination of the concept of statistical significance makes statements which have much to say to those engaged in exploratory research:

"... the finding of statistical significance is perhaps the least important attribute of a good experiment; it is never a sufficient condition for concluding that a theory has been corroborated, that a useful empirical fact has been established with reasonable confidence... The value of any research can be determined, not from statistical results, but only by skilled subjective evaluation of the coherence and reasonableness of the theory, the degree of experimental control employed, the sophistication of the measuring techniques, the scientific or practical importance of the phenomena studied, and so on."

Whilst one may accept Lykken's statement with some reservations, the very exploratory findings of this research need to be viewed with something of this caution. They should be seen as contributing to a re-conception of what 'creative ability' is, and as such, giving direction to necessary replication studies.

Statistical analysis has, however, a very valuable role to play in exploratory work. Statistical confirmation leads one back to the theory to seek a more adequate explanation for this confirmation. A lack of statistical support should do likewise. Further, both confirmation and lack of confirmation should be adequately questioned lest they stem from some statistical artefact as opposed to being rooted in the theory. This comment will be amplified as different statistical relationships are considered, and analysis will finally be related to the theory.

Aims of the Statistical Analysis

A major aim of this analysis was to examine the coherence of the battery of tasks by considering relationships between each of the tasks, both generally and for specific age ranges, and by examining any variations in performance between boys and girls.

It was assumed that there would be a marked improvement in performance with age on all of the tasks, and the researcher wished to examine this assumption. The two main statistical methods used for this analysis were contingency tables and analysis of variance.

Chi-Square Contingency Tests

Contingency tests were used to examine the following relationships:

- a) relationships between each of the tasks based on the responses of all subjects;
- b) relationships between each of the tasks based on the responses of the older (10-13 years) subjects only;
- c) differences between the sexes.

Siegel (1956) points out that the contingency table is perhaps the most commonly employed form of the Chi-Square Test. The formula contains a correction for continuity (Yates) intended to make the approximation to the theoretical chi-square distribution more precise (McCall, 1970 and Siegel, 1956).

The Test requires (Cochran, 1954 and Siegel, 1956) that the expected frequencies in each cell should not be too small. The two groups must, of course be independently and randomly sampled and each observation must qualify for one category and only one category. Discussing the power of the X^2 , Siegel points out that this is in fact difficult to compute for often the X^2 test is employed when there is no clear alternative.

The test is used to discover whether two (as in this case) or more factors are independent. The statistical test criteria used is:

$$X_2 = \sum_{i=1}^I \frac{(O_i - E_i)^2}{E_i}$$

where I is the total number of 'cells' or classes (in this case four - pass/pass, pass/fail, fail/pass, fail/fail).

O_i is the observed frequency in cell i

E_i is the expected frequency in cell i

(Methods of calculating the E_i s will be shown later). It can be shown that (see S.D. Silvey - "Statistical Inference") this X_2 statistic has in fact a X_2 distribution with the number of degrees of freedom equal to (No. of rows - 1) x (No. of Cols - 1) as we are subjected to the one linear constraint:

$$\sum_{i=1}^I (O_i - E_i) = 0 \text{ as } \sum_{i=1}^I O_i = \sum_{i=1}^I E_i = N$$

where N is the total number of observations.

For all tests on relationships between tests in the analysis, a standard contingency test was used for testing independence between each pair of tasks. The statistical assumption (the 'null hypothesis' - H_0) is then:

H_0 : the two tests are independent

Assuming we have two tasks, A and B, denote class i of test A by A_i , similarly for B.

Then letting

$$\begin{aligned} P_{ij} &= P(\text{observation falls in } (A_i, B_j) \text{ when chosen at random}) \\ &= P(\text{observation falls in } A_i \text{ and in } B_j \text{ when chosen at random}) \end{aligned}$$

Now under the null hypothesis (that is when the two tests are independent) we can write this:

$$\begin{aligned} P_{ij} &= P(\text{observation falls in } A_i) \times P(\text{observation falls in } B_j) \\ &= P_i q_j. \end{aligned}$$

Now the expected frequency for cell (A_i, B_j) under H_0 is $nP_i q_j$, but we do not usually know the values of P_i or q_j . So we estimate these probabilities by (estimates denoted by an "n").

$$\begin{aligned} \hat{P}_i &= R_i/n \\ \hat{q}_j &= C_j/n \end{aligned}$$

where $R_i = \text{Sum of row } i$ } assuming the first factor, A, has its
 $C_j = \text{Sum of column } j$ } different levels as the rows.
 $n = \text{Total number of observations.}$

Hence the standard chi-squared statistic with one degree of freedom is given by:

$$\sum_{i=1}^r \sum_{j=1}^s \frac{(n_{ij} - \frac{R_i C_j}{n})^2}{\frac{R_i C_j}{n}} = X_2$$

where $r = \text{Number of rows (i.e. levels of factor A)}$
 $s = \text{Number of columns (i.e. levels of factor B)}$
 $n_{ij} = \text{Number of observations in cell } (i, j)$
 $d.f = (r - 1) \times (s - 1)$

The expected frequencies are calculated from:

$$nP_i q_j = n \hat{P}_i \hat{q}_j = n \times \frac{R_i}{n} \times \frac{C_j}{n} = \frac{R_i C_j}{n}$$

We then test our X_2 against the standard X_2 statistic with relevant degrees of freedom.

However, with only two factors with two levels, we are dealing essentially with a Binomial type problem. A mathematical difficulty arises from the fact that the X_2 distribution is continuous whereas the Binomial is not. This difficulty is overcome by using a correction suggested by Yates which consists of reducing the value of $(O_i - E_i)$ by $\frac{1}{2}$ before squaring, in other words, we decrease those observed frequencies which exceed the expected frequencies by a half and increase those that are less than the expected by a half. Denoting these new, corrected, observed frequencies by n_{ij} , our run test criterion is:

$$X_2 = \sum_{i=1}^r \sum_{j=1}^s \frac{(n_{ij} - \frac{R_i C_j}{n})^2}{\frac{R_i C_j}{n}}$$

and we test this for significance against the percentage point of the X_2 distribution with one degree of freedom.

Note: $X_2 - 5\% = 3.84$
 $X_2 - 1\% = 6.63$

Analysis of Variance

This test was used less widely than the previous statistical test. Its particular value lies in the fact that it enables more than one condition to be studied simultaneously and it was employed to examine any variations in performance due to age or sex.

Several assumptions need to be satisfied before a parametric F Test can be applied to data. When these assumptions are valid, this Test is one of the most likely to reject H_0 , when H_0 is false (Siegel, 1956) Essential assumptions include those required for the t Test, namely that:

- a) populations from which the groups are drawn have equal variances;
 (However, McCall, 1970, points out that:

"If a sufficient number of cases are sampled and the number of subjects in each group is the same, moderate violations of this assumption do not alter the result of the analysis of variance very much." P.231.)

- b) that the groups involved are composed of randomly sampled subjects and are independent from one another;
 c) that the distribution of each population is normal in form (this should be reflected in each of the groups sampled) (McCall, 1970).

In addition, analysis of variance (F - Test) requires that:

- c) the variables involved be measured in at least an interval scale.

It is accepted that this latter condition can be the most contentious in the matter of choosing a powerful parametric measure. However, it is argued that the 'intervals' of measurement employed in the tasks in this research are not open to any special or added problems. The 'precise distances' between 'passing', 'partially-succeeding' and 'failing' are no more problem-loaded than the 'precise distances' between responses on say, a five point scale (see Siegal, 1956, on the assumption that "yes/no responses" can be used to create an interval scale). In this research where transformations of reality are seen as having starting points, qualitatively different intermediary points and completion points, it has been assumed that such points have equivalence across tasks, and that "pass"/"fail" categories in particular have this equivalence.

Analysis of variance is a technique by which variations attributed to different defined sources may be isolated and estimated. It is generally used for two main purposes:

McCall. R (1970) Ibid. P.231.

Siegal, S. (1956) Ibid. P.56.

- a) to make estimates of variance components;
- b) to test whether variability that is suspected of being systematic in character, attributable to a specific cause, is significantly larger than that which is considered to be random in character.

To test for significance the standard F statistic was used. The basis of the method is to split up the total variation within the observations into "Sums of Squares" which represent the variation attributable to certain causes. The calculations of the analysis of variance table were set down as follows:

Source of Information	Degrees of Freedom	Sum of Squares	Mean Squares
Sex	1	$\sum T_i^2 / n_{jnk} - \sum \sum T_{ij}^2 / n_i n_j n_k$	$SS/1 = MS_s$
Age	7	$\sum T_j^2 / n_{ink} - \sum \sum T_{ij}^2 / n_i n_j n_k$	$SS/7 = MS_a$
Sex x Age	7	$\sum \sum T_{ij}^2 / n_k - \text{SEX EFFECT} - \text{AGE EFFECT} - \sum \sum T_{ij}^2 / n_i n_j n_k$	$SS/7 = MS_{sa}$
Error	80	Total - Sex - Age - Sex x Age Effects	$SS/80 = MS_e$
TOTAL	95	$\sum T_{ij} - \sum \sum T_{ij}^2 / n_i n_j n_k$	

F ratios are: $F(1,80) \quad MS_{sex} / MS_{Error}$

$F(7,80) \quad MS_{age} / MS_{Error}$

$F(7,80) \quad MS_{sxa} / MS_{Error}$

Where in this case (Part 1), there are 96 pupils in total, 2 sexes (d.f = Number of sexes - 1), 8 age groups (d.f = Number of ages - 1)

i.e. n_i = Number of sexes = 2

n_j = Number of ages = 8

n_k = Number of observations in each group = 6

T_i = Total for sex i

T_j = Total for age group j

T_{ij} = Number of successes in age group j for sex i

The error terms are a measure of the variation attributable to error or random variation. So using this technique it is possible to dissect the variation to attributable causes and a random effect represented by the error terms. By testing the ratios of 'factor Sum of Squares' to error sum of squares significance of variation can be tested.

An added advantage is that one can test for variation within each factor, independently of the situation with the other factors. (i.e. it is possible to test for a significant difference in ages regardless of the possibility of a difference in sexes.) The interaction term gives a measure of the effect of each factor (sex and age) upon the other (e.g. whether in this analysis (Part 2) - girls tend to perform better than boys during the ages 9-10 but not when younger.)

Summary

Hence the analysis of variance is a powerful method of disentangling the relationships present in the data by taking the overall variance and breaking it down into a number of components each of which can be assigned to a specific factor, plus an error (or 'residual') component which represents the inherent variability of the data when the assignable effects have been removed.

Significance level

When testing statistical hypotheses, one can never be absolutely certain in the acceptance or rejection of the hypothesis. The researcher works with the knowledge that it is possible for a test to reject a hypothesis (e.g. two tests are independent) when in fact the hypothesis is true in reality. The 'significance level' of the test overcomes this difficulty somewhat.

One-Tailed Tests

All the analysis of variance tests were one-sided (one-tailed tests) since we were comparing the hypothesis that the variation due to sex or age is greater than the underlying random variation. We were not interested in the case where this "explained" variation is less than random. The contingency tests are also one-sided as we again test for large values of X^2 , i.e. cases where the computed X^2 is greater than that which could arise 5% of the time by chance.

A one-tailed test is more powerful than a two-tailed test (Siegel, 1956).

EXPLANATION OF TABLES (which follow)

Set 1 - Standard F Tests (Analysis of Variance)

These tables are the standard Analysis of Variance tables for detecting variation amongst several factors. The first table for each test is simply a tabulation of the number of passes obtained by each sex at each age.

The ANOVA table shows the calculations up to the calculation of the F ratio.

Set 2 - Relationships between Totals

Initially the overall totals for each pair of tests was tested (that is, totals over age and sex). This set shows the frequencies for each possible pass/fail combination. Figures in green represent observed frequencies, black the observed corrected by Yates Correction and the red the expected frequency calculated by:

Row x Col
Total

We are hence testing for independence between the two tests (a significant result representing dependence). It will be noted that in all cases but two, significance was obtained on the 5% level ($\chi^2_{.05} = 3.84$).

Set 3 - Relationships between tasks for Sexes

After testing the total scores and obtaining a high degree of significance, tests were carried out for any differences between the tasks, comparing the older girls' (i.e. 10, 11, 12, 13) scores with one half of the total scores for older boys plus girls (thus testing for differences between sexes). The tables show the observed frequency in green, black is the corrected observed frequency and red is the expected frequency, being in fact $\frac{1}{2}$ x total scores.

SET 1 - STANDARD F TESTS

(Differences between sexes and ages)

CALCULATIONS FOR THE VARIOUS EFFECTS

Sex $\frac{\sum \bar{T}_{i.}^2}{h_j h_k} - CF.$

Age $\frac{\sum \bar{T}_{.j}^2}{h_i h_k} - CF.$

Sex x Age $\frac{\sum \sum \bar{T}_{ij}^2}{h_k} - \text{sex effects} - \text{Age Effect} + CF.$

Total $\sum \sum \bar{T}_{ij} - \frac{\sum \sum \bar{T}_{ij}^2}{h_i h_j h_k}$

Residual $TOTAL - SEX - AGE - SEX \times AGE.$

Correction factor $\frac{\sum \sum \bar{T}_{ij}^2}{h_i h_j h_k}.$

n_i = Number of successes = 2

n_j = Number of ages = 8

n_k = Number per cell = 6

TEST: ELABORATION

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	0	0	0	0	3	2	3	4	12
BOYS:	0	0	1	2	1	3	3	2	12
	0	0	1	2	4	5	6	6	24.

ANOVA:

	SS	df	MS	F-ratio
SEX	0	1	0	-
AGE	3.3333	7	0.55	3.385 *
SEX x AGE	1.1667	7	.1667	1.026
ERROR	13	80	0.1625	
TOTAL	18	95		

* Significant at the 0.5% level.

TEST: FREE PROBLEM SOLVING

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	0	0	0	0	2	2	4	5	13
BOYS:	0	0	0	2	2	2	3	4	13
	0	0	0	2	4	4	7	9	26.

ANOVA:

	SS	df	MS	F-ratio
SEX	0	1	0	-
AGE	6.792	7	0.9702	6.836 *
SEX x AGE	0.5	7	0.0714	0.488
ERROR	11.693	80	0.1462	
TOTAL	18.985	95.		

* Significant at the 0.1 % level.

TEST: IDENTITY RECOGNITION.

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	1	0	1	3	3	3	4	4	19
BOYS:	0	0	2	1	3	3	4	4	17
	1	0	3	4	6	6	8	8	36.

ANOVA:

	SS	df	MS	F-ratio
SEX	0.04167	1	0.04167	0.2.
AGE	5.3333	7	0.7619	3.657 *
SEX x AGE	0.4683	7	0.0654	0.314.
ERROR	16.6666	80	0.2083	
TOTAL	22.5	95		

* Significant at the 0.1 % level.

TEST: IDENTITY RECONSTRUCTION (1)

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	0	0	0	2	1	1	3	3	10
BOYS:	0	0	2	1	2	2	2	3	12
	0	0	2	3	3	3	5	6	22.

ANOVA:

	SS	df	MS	F-ratio
SEX	0.04167	1	0.04167	0.243
AGE	2.625	7	0.375	2.185 *
SEX x AGE	0.625	7	0.0892	0.52.
ERROR	13.7279	80	0.1716	
TOTAL	16.958	95		

* Significant at the 5 % level.

TEST: WHAT WOULD HAPPEN IF.

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	0	0	1	2	3	3	5	5	19
BOYS:	0	0	1	3	3	4	5	4	20
	0	0	2	5	6	7	10	9	29.

ANOVA:

	SS	df	MS	F-ratio
SEX	0.0104	1	0.0104	0.058.
AGE	8.7295	7	1.2485	7.05 *
SEX x AGE	0.2396	7	0.0342	0.193.
ERROR	14.1671	80	0.1771.	
TOTAL	23.1563	95		

* Significant at the 0.1 % level.

TEST: RECLASSIFICATION

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	0	0	0	0	1	2	3	4	10
BOYS:	0	0	1	1	1	2	3	3	11
	0	0	1	1	2	4	6	7	21

ANOVA:

	SS	df	MS	F-ratio
SEX	0.01042	1	0.01042	0.182.
AGE	4.3229	7	0.6176	10.76 *
SEX x AGE	0.2396	7	0.0342	0.596
ERROR	4.5937	80	0.0574	
TOTAL	9.1666	95		

* Significant at the 0.1 % level.

TEST: IDENTITY RECONSTRUCTION(2)

(years)	6	7	8	9	10	11	12	13	Total.
GIRLS:	0	0	0	2	2	2	2	4	12
BOYS:	0	1	2	1	3	4	3	3	17
	0	1	2	3	5	6	5	7	29

ANOVA:

	SS	df	MS	F-ratio
SEX	0.2604	1	0.2604	1.344.
AGE	3.6562	7	0.5223	2.696 *
SEX x AGE	0.823	7	0.1176	0.607.
ERROR	15.5	80	0.19375	
TOTAL	20.2396	95		

* Significant at the 2.5% level.

SET 2 - CONTINGENCY TESTS

(Relationships between Totals)

(A) (B)

RELATIONSHIP: ELABORATION/FREE PROBLEM SOLVING

A \ B	FAIL	PASS	TOTAL
FAIL	<u>61</u> 60½ <u>52½</u> <u>9</u> 9½ <u>17½</u> <u>70</u>		
PASS	<u>11</u> 11½ <u>19½</u> <u>15</u> 14½ <u>6½</u> <u>26</u>		
TOTAL	<u>72</u>	<u>24</u>	<u>96</u>

$$\chi^2 = 18.00$$

(A) (C)

RELATIONSHIP: ELABORATION/IDENTITY RECOGNITION

A \ C	FAIL	PASS	TOTAL
FAIL	<u>51</u> 50½ <u>45</u> <u>21</u> 21½ <u>27</u> <u>72</u>		
PASS	<u>9</u> 9½ <u>15</u> <u>15</u> 14½ <u>9</u> <u>24</u>		
TOTAL	<u>60</u>	<u>36</u>	<u>96</u>

$$\chi^2 = 7.17$$

(A) (D)

RELATIONSHIP: ELABORATION/IDENTITY RECONSTRUCTION(1)

A \ D	FAIL	PASS	TOTAL
FAIL	<u>64</u> 63.555 <u>55.5</u> <u>8</u> 8.5 <u>16.5</u> <u>72</u>		
PASS	<u>10</u> 10.5 <u>18.5</u> <u>14</u> 13.555 <u>5.5</u> <u>24</u>		
TOTAL	<u>74</u>	<u>22</u>	<u>96</u>

$$\chi^2 = 20.13$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

(A) (E)
 RELATIONSHIP: ELABORATION/WHAT WOULD HAPPEN IF?

A \ E	FAIL	PASS	TOTAL
FAIL	<u>50</u> 49.5 <u>42</u>	<u>22</u> 22.5 <u>30</u>	<u>72</u>
PASS	<u>6</u> 6.5 <u>14</u>	<u>18</u> 17.5 <u>10</u>	<u>24</u>
TOTAL	<u>56</u>	<u>40</u>	<u>96</u>

$$\chi^2 = 12.86$$

(A) (F)
 RELATIONSHIP: ELABORATION/RECLASSIFICATION

A \ F	FAIL	PASS	TOTAL
FAIL	<u>64</u> 63.5 <u>56</u> 25	<u>8</u> 8.5 <u>15</u> 75	<u>72</u>
PASS	<u>11</u> 11.5 <u>12</u> 75	<u>13</u> 12.5 <u>5</u> 25	<u>24</u>
TOTAL	<u>75</u>	<u>21</u>	<u>96</u>

$$\chi^2 = 17.09$$

(A) (G)
 RELATIONSHIP: ELABORATION/IDENTITY RECONSTRUCTION(2)

A \ G	FAIL	PASS	TOTAL
FAIL	<u>59</u> 58.5 <u>51</u> 7	<u>14</u> 14.5 <u>21</u> 3	<u>73</u>
PASS	<u>7</u> 9.5 <u>6</u> 3	<u>14</u> 13.5 <u>6</u> 7	<u>23</u>
TOTAL	<u>68</u>	<u>28</u>	<u>96</u>

$$\chi^2 = 12.80$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

(B)

(C)

RELATIONSHIP: FREE PROBLEM/IDENTITY RECOGNITION

B \ C	FAIL	PASS	TOTAL
FAIL	<u>50</u> ^{49.5} <u>42.4</u>	<u>19</u> ^{19.5} <u>26.6</u>	<u>69</u>
PASS	<u>9</u> ^{9.5} <u>16.6</u>	<u>18</u> ^{17.5} <u>10.4</u>	<u>27</u>
TOTAL	<u>59</u>	<u>37</u>	<u>96</u>

$$\chi^2 = 10.97$$

(B)

(D)

RELATIONSHIP: FREE PROBLEM/ IDENTITY RECONSTRUCTION(1)

B \ D	FAIL	PASS	TOTAL
FAIL	<u>62</u> ^{61.5} <u>54</u>	<u>8</u> ^{8.5} <u>16</u>	<u>70</u>
PASS	<u>12</u> ^{12.5} <u>20</u>	<u>14</u> ^{13.5} <u>6</u>	<u>26</u>
TOTAL	<u>74</u>	<u>22</u>	<u>96</u>

$$\chi^2 = 16.75$$

(B)

(E)

RELATIONSHIP: FREE PROBLEM/ WHAT WOULD HAPPEN IF?

B \ E	FAIL	PASS	TOTAL
FAIL	<u>51</u> ^{50.5} <u>40.8</u>	<u>19</u> ^{19.5} <u>29.2</u>	<u>70</u>
PASS	<u>5</u> ^{5.5} <u>15.2</u>	<u>21</u> ^{20.5} <u>10.8</u>	<u>26</u>
TOTAL	<u>56</u>	<u>40</u>	<u>96</u>

$$\chi^2 = 20.43$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

(B) (F)

RELATIONSHIP: FREE PROBLEM/RECLASSIFICATION

B \ F	FAIL	PASS	TOTAL
FAIL	<u>67</u> ^{66.5} <u>54.7</u>	<u>3</u> ^{3.5} <u>15.3</u>	<u>70</u>
PASS	<u>8</u> ^{8.5} <u>20.3</u>	<u>18</u> ^{17.5} <u>5.7</u>	<u>26</u>
TOTAL	<u>75</u>	<u>21</u>	<u>96</u>

$$\chi^2 = 42.94$$

(B) (G)

RELATIONSHIP: FREE PROBLEM/IDENTITY RECONSTRUCTION(2)

B \ G	FAIL	PASS	TOTAL
FAIL	<u>54</u> ^{53.5} <u>48.9</u>	<u>16</u> ^{16.5} <u>21.2</u>	<u>70</u>
PASS	<u>13</u> ^{13.5} <u>18.1</u>	<u>13</u> ^{12.5} <u>7.9</u>	<u>26</u>
TOTAL	<u>67</u>	<u>29</u>	<u>96</u>

$$\chi^2 = 5.32$$

(C) (D)

RELATIONSHIP: IDENTITY RECOGNITION/IDENTITY RECONSTRUCTION

C \ D	FAIL	PASS	TOTAL
FAIL	<u>55</u> ^{54.5} <u>46.4</u>	<u>6</u> ^{6.5} <u>14.6</u>	<u>61</u>
PASS	<u>18</u> ^{18.5} <u>26.6</u>	<u>17</u> ^{16.5} <u>8.4</u>	<u>35</u>
TOTAL	<u>73</u>	<u>23</u>	<u>96</u>

$$\chi^2 = 16.18$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

(C) (E)
 RELATIONSHIP: IDENTITY RECOGNITION/WHAT WOULD HAPPEN IF?

C \ E	FAIL	PASS	TOTAL
FAIL	<u>45</u> 44.5 35.6	<u>15</u> 15.5 24.4	<u>60</u>
PASS	<u>12</u> 12.5 21.4	<u>24</u> 23.5 14.1	<u>36</u>
TOTAL	<u>57</u>	<u>39</u>	<u>96</u>

$$\chi^2 = 14.6$$

(C) (F)
 RELATIONSHIP: IDENTITY RECOGNITION/RECLASSIFICATION

C \ F	FAIL	PASS	TOTAL
FAIL	<u>53</u> 52.5 47.0	<u>8</u> 8.5 14	<u>61</u>
PASS	<u>21</u> 21.5 27	<u>14</u> 13.5 8	<u>35</u>
TOTAL	<u>74</u>	<u>22</u>	<u>96</u>

$$\chi^2 = 7.71$$

(C) (G)
 RELATIONSHIP: IDENTITY RECOGNITION/IDENTITY RECONSTRUCTION(2)

C \ G	FAIL	PASS	TOTAL
FAIL	<u>50</u> 41.5 40.7	<u>11</u> 11.5 20.3	<u>61</u>
PASS	<u>14</u> 14.5 23.3	<u>21</u> 20.5 11.7	<u>35</u>
TOTAL	<u>64</u>	<u>32</u>	<u>96</u>

$$\chi^2 = 15.66$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

(D)

(E)

293.

RELATIONSHIP: IDENTITY RECONSTRUCTION(1)/WHAT WOULD HAPPEN IF?

D \ E	FAIL	PASS	TOTAL
FAIL	<u>52</u> ^{51.5} <u>43.2</u>	<u>22</u> ^{22.5} <u>30.8</u>	<u>74</u>
PASS	<u>4</u> ^{4.5} <u>12.8</u>	<u>18</u> ^{17.5} <u>9.2</u>	<u>22</u>
TOTAL	<u>56</u>	<u>40</u>	<u>96</u>

$$\chi^2 = 16.70$$

(D)

(F)

RELATIONSHIP: IDENTITY RECONSTRUCTION(1) RECLASSIFICATION

D \ F	FAIL	PASS	TOTAL
FAIL	<u>63</u> ^{62.5} <u>58.6</u>	<u>11</u> ^{11.5} <u>15.4</u>	<u>74</u>
PASS	<u>13</u> ^{13.5} <u>17.4</u>	<u>9</u> ^{9.5} <u>4.6</u>	<u>22</u>
TOTAL	<u>76</u>	<u>20</u>	<u>96</u>

$$\chi^2 = 2.12$$

(D)

(G)

RELATIONSHIP: IDENTITY RECONSTRUCTION (1)/IDENTITY RECON.(2)

D \ G	FAIL	PASS	TOTAL
FAIL	<u>63</u> ^{62.5} <u>53.1</u>	<u>12</u> ^{12.5} <u>21.9</u>	<u>75</u>
PASS	<u>5</u> ^{5.5} <u>14.9</u>	<u>16</u> ^{15.5} <u>6.1</u>	<u>21</u>
TOTAL	<u>68</u>	<u>28</u>	<u>96</u>

$$\chi^2 = 26.11$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

(E)

(F)

RELATIONSHIP: WHAT WOULD HAPPEN IF?/RECLASSIFICATION

E \ F	FAIL	PASS	TOTAL
FAIL	<u>52</u> ^{61.5} <u>43.9</u>	<u>5</u> ^{5.5} <u>13.1</u>	<u>57</u>
PASS	<u>22</u> ^{22.5} <u>30.1</u>	<u>17</u> ^{16.5} <u>8.9</u>	<u>39</u>
TOTAL	<u>74</u>	<u>22</u>	<u>96</u>

$$\chi^2 = 19.87$$

(E)

(G)

RELATIONSHIP: WHAT WOULD HAPPEN IF?/IDENTITY RECONSTRUCTION(2)

E \ G	FAIL	PASS	TOTAL
FAIL	<u>45</u> ^{44.5} <u>39.1</u>	<u>11</u> ^{11.5} <u>16.9</u>	<u>56</u>
PASS	<u>22</u> ^{22.5} <u>27.9</u>	<u>18</u> ^{17.5} <u>12.1</u>	<u>40</u>
TOTAL	<u>67</u>	<u>29</u>	<u>96</u>

$$\chi^2 = 5.92$$

(F)

(G)

RELATIONSHIP: RECLASSIFICATION/IDENTITY RECONSTRUCTION(2)

E \ G	FAIL	PASS	TOTAL
FAIL	<u>55</u> ^{54½} <u>52.3</u>	<u>20</u> ^{20½} <u>22.7</u>	<u>75</u>
PASS	<u>12</u> ^{12½} <u>14.7</u>	<u>9</u> ^{8½} <u>6.3</u>	<u>21</u>
TOTAL	<u>67</u>	<u>29</u>	<u>96</u>

$$\chi^2 = 1.40$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

SET 3 - CHI-SQUARED TESTS

(Relationships between Tasks for Sexes)

(Older subjects, 10-13 years only)

Note: After testing the total scores (Set 2 Tables) and obtaining a high degree of significance, tests were carried out for any differences between the tasks, comparing the older girls' scores with one half of the total scores for the older boys plus girls. (Thus testing the differences between sexes.)

A B

RELATIONSHIP: ELABORATION/FREE PROBLEM SOLVING.

GIRLS - OLD/1/2 TOTAL.

A \ B	FAIL	PASS	TOTAL
FAIL	7 ^{6.5} <u>6.5</u>	4 ^{4.5} <u>4.5</u>	11
PASS	5 ^{5.5} <u>5.5</u>	8 ^{7.5} <u>7.5</u>	13
TOTAL	12	12	24

$$\chi^2 = 0.185.$$

A B

RELATIONSHIP: ELABORATION/FREE - PROBLEM SOLVING.

OLDER Ss.

A \ B	FAIL	PASS	TOTAL
FAIL	16 ^{15.5} <u>13.5</u>	8 ^{8.5} <u>10.5</u>	24
PASS	11 ^{11.5} <u>13.5</u>	13 ^{12.5} <u>10.5</u>	24
TOTAL	27	21	48

$$\chi^2 = 2.116$$

A C

RELATIONSHIP: ELABORATION/IDENTITY RECOGNITION.

Girls - Old/1 Total.

A \ C	FAIL	PASS	TOTAL
FAIL	8 ^{6.5} <u>7.5</u>	4 ^{4.5} <u>5.5</u>	<u>12</u>
PASS	2 ^{2.5} <u>3.5</u>	10 ^{9.5} <u>8.5</u>	<u>12</u>
TOTAL	<u>10</u>	<u>14</u>	<u>24</u>

$$\chi^2 = 2.225$$

A C

RELATIONSHIP: ELABORATION/IDENTITY RECOGNITION

Total Old.

A \ C	FAIL	PASS	TOTAL
FAIL	13 ^{12.5} <u>10.25</u>	14 ^{13.5} <u>15.75</u>	<u>27</u>
PASS	7 ^{7.5} <u>8.75</u>	14 ^{13.5} <u>12.25</u>	<u>21</u>
TOTAL	<u>20</u>	<u>28</u>	<u>48</u>

$$\chi^2 = 0.544$$

A D

RELATIONSHIP: ELABORATION/IDENTITY RECONSTRUCTION(1)

Old Girls/ $\frac{1}{2}$ Total.

A \ D	FAIL	PASS	TOTAL
FAIL	11 ^{10.5} <u>9.5</u>	1 ^{1.5} <u>2.5</u>	<u>12</u>
PASS	5 ^{5.5} <u>6.5</u>	7 ^{6.5} <u>5.5</u>	<u>12</u>
TOTAL	<u>16</u>	<u>8</u>	<u>24</u>

$$\chi^2 = 0.442.$$

A D

RELATIONSHIP: ELABORATION/IDENTITY RECONSTRUCTION(1)

Total Old.

A \ D	FAIL	PASS	TOTAL
FAIL	22 ^{20.5} <u>17.34</u>	5 ^{5.5} <u>7.56</u>	<u>27</u>
PASS	9 ^{9.5} <u>14.44</u>	12 ^{11.5} <u>7.44</u>	<u>21</u>
TOTAL	<u>31</u>	<u>17</u>	<u>48</u>

$$\chi^2 = 7.704$$

A E

RELATIONSHIP: ELABORATION/ WHAT WOULD HAPPEN IF.

Old Girls/1 TOTAL.

A \ E	FAIL	PASS	TOTAL
FAIL	6 5.5 <u>4.5</u>	6 6.5 <u>7.5</u>	<u>12</u>
PASS	2 2.5 <u>3.5</u>	10 7.5 <u>8.5</u>	<u>12</u>
TOTAL	<u>8</u>	<u>16</u>	<u>24</u>

$$\chi^2 = 0.563.$$

A E

RELATIONSHIP: ELABORATION/WHAT WOULD HAPPEN IF.

TOTAL OLD.

A \ E	FAIL	PASS	TOTAL
FAIL	11 10.5 <u>9</u>	16 16.5 <u>18</u>	<u>27</u>
PASS	5 5.5 <u>7</u>	16 15.5 <u>14</u>	<u>21</u>
TOTAL	<u>16</u>	<u>32</u>	<u>48</u>

$$\chi^2 = 0.857.$$

A F

RELATIONSHIP: ELABORATION/RECLASSIFICATION.

Old Girls/ $\frac{1}{2}$ Total

A \ F	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 9 \quad 8.5 \\ \hline 9.5 \end{array}$	$\begin{array}{r} 3 \quad 3.5 \\ \hline 3.5 \end{array}$	12
PASS	$\begin{array}{r} 5 \quad 5.5 \\ \hline 4.5 \end{array}$	$\begin{array}{r} 7 \quad 6.5 \\ \hline 7.5 \end{array}$	12
TOTAL	14	10	24

$$\chi^2_1 = 0.067$$

A F

RELATIONSHIP: ELABORATION/RECLASSIFICATION.

Total Old.

A \ F	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 20 \quad 19.5 \\ \hline 16.31 \end{array}$	$\begin{array}{r} 7 \quad 7.5 \\ \hline 10.69 \end{array}$	27
PASS	$\begin{array}{r} 9 \quad 9.5 \\ \hline 12.69 \end{array}$	$\begin{array}{r} 12 \quad 11.5 \\ \hline 8.31 \end{array}$	21
TOTAL	29	19	48

$$\chi^2_1 = 3.60$$

A 9

RELATIONSHIP: ELABORATION/IDENTITY RECOGNITION(2)

Old Girls/ $\frac{1}{2}$ Total.

A \ 9	FAIL	PASS	TOTAL
FAIL	<u>10</u> ^{9.5} 9.5	<u>3</u> ^{2.5} 3.5	<u>13</u>
PASS	<u>5</u> ^{5.5} 5.5	<u>6</u> ^{5.5} 5.5	<u>11</u>
TOTAL	<u>15</u>	<u>9</u>	<u>24</u>

$$\chi^2 = 0.540$$

A 9

RELATIONSHIP: ELABORATION/IDENTITY RECOGNITION(2)

TOTAL OLD.

A \ 9	FAIL	PASS	TOTAL
FAIL	<u>18</u> ^{17.5} 15.2	<u>10</u> ^{10.5} 12.8	<u>28</u>
PASS	<u>8</u> ^{8.5} 10.2	<u>12</u> ^{11.5} 9.2	<u>20</u>
TOTAL	<u>26</u>	<u>22</u>	<u>48</u>

$$\chi^2 = 1.83$$

B

C

RELATIONSHIP: FREE PROBLEM SOLVING/IDENTITY RECOGNITION

Old Girls/ $\frac{1}{2}$ Total.

B \ C	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 5 \\ \hline \end{array} 4.5$ $\begin{array}{r} 4.5 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ \hline \end{array} 6.5$ $\begin{array}{r} 6.5 \\ \hline \end{array}$	<u>11</u>
PASS	$\begin{array}{r} 5 \\ \hline \end{array} 5.5$ $\begin{array}{r} 5.5 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ \hline \end{array} 7.5$ $\begin{array}{r} 7.5 \\ \hline \end{array}$	<u>13</u>
TOTAL	<u>10</u>	<u>14</u>	<u>24</u>

$$\chi^2 = 0.063$$

B

C

RELATIONSHIP: FREE PROBLEM SOLVING/IDENTITY RECOGNITION

Total Old.

B \ C.	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 11 \\ \hline \end{array} 10.5$ $\begin{array}{r} 9.11 \\ \hline \end{array}$	$\begin{array}{r} 12 \\ \hline \end{array} 12.5$ $\begin{array}{r} 13.11 \\ \hline \end{array}$	<u>23</u>
PASS	$\begin{array}{r} 8 \\ \hline \end{array} 8.5$ $\begin{array}{r} 9.89 \\ \hline \end{array}$	$\begin{array}{r} 17 \\ \hline \end{array} 16.5$ $\begin{array}{r} 15.11 \\ \hline \end{array}$	<u>25</u>
TOTAL	<u>9</u>	<u>29</u>	<u>48</u>

$$\chi^2 = 0.680$$

B D

RELATIONSHIP: FREE PROBLEM SOLVING/IDENTITY RECONSTRUCTION(1)

Old Girls/1 Total.

B \ D	FAIL	PASS	TOTAL
FAIL	9 8.5 9.5 <u> </u>	2 2.5 1.5 <u> </u>	<u>11</u>
PASS	7 7.5 6.5 <u> </u>	6 5.5 6.5 <u> </u>	<u>13</u>
TOTAL	<u>16</u>	<u>8</u>	<u>24</u>

$$\chi^2 = 0.207.$$

B D

RELATIONSHIP: FREE PROBLEM SOLVING/IDENTITY RECONSTRUCTION(1)

Total Old.

B \ D	FAIL	PASS	TOTAL
FAIL	20 19.5 15.5 <u> </u>	4 4.5 2.5 <u> </u>	<u>24</u>
PASS	11 11.5 15.5 <u> </u>	13 12.5 8.5 <u> </u>	<u>24</u>
TOTAL	<u>31</u>	<u>17</u>	<u>48</u>

$$\chi^2 = 5.83$$

B

E

RELATIONSHIP: FREE PROBLEM SOLVING/WHAT WOULD HAPPEN IF.

Old Girls/ $\frac{1}{2}$ Total.

B \ E	FAIL	PASS	TOTAL
FAIL	7 ^{6.5} <u>5.5</u>	4 ^{4.5} <u>5.5</u>	11
PASS	1 ^{1.5} <u>2.5</u>	12 ^{11.5} <u>12.5</u>	13
TOTAL	8	16	24.

$$\chi^2 = 1.618$$

RELATIONSHIP: FREE PROBLEM SOLVING/WHAT WOULD HAPPEN IF.

Total Old.

B \ E.	FAIL	PASS	TOTAL
FAIL	11 ^{10.5} <u>8</u>	13 ^{13.5} <u>16</u>	24
PASS	5 ^{5.5} <u>8</u>	19 ^{18.5} <u>16</u>	24
TOTAL	16	32	48

$$\chi^2 = 2.344$$

B F

RELATIONSHIP: FREE PROBLEM SOLVING/RECLASSIFICATION.

Old Girls/ $\frac{1}{2}$ Total.

B \ F	FAIL	PASS	TOTAL
FAIL	11 ^{10.5} <u>11</u> 10.5	0 ^{0.5} <u>0</u> 0.5	11
PASS	3 ^{3.5} <u>3</u> 3.5	10 ^{9.5} <u>10</u> 8.5	13
TOTAL	14	10	24

$$\chi^2 = 0.368$$

B F

RELATIONSHIP: FREE PROBLEM SOLVING/RECLASSIFICATION.

Total Old.

B \ F	FAIL	PASS	TOTAL
FAIL	22 ^{21.5} <u>22</u> 14.5	2 ^{2.5} <u>2</u> 9.5	24
PASS	7 ^{7.5} <u>7</u> 14.5	17 ^{16.5} <u>17</u> 9.5	24
TOTAL	29	19	48

$$\chi^2 = 17.08$$

8

9

RELATIONSHIP: FREE PROBLEM SOLVING/IDENTITY RECONSTRUCTION(2)

Old Girls/ $\frac{1}{2}$ Total.

8 \ 9	FAIL	PASS	TOTAL
FAIL	6 ^{5.5} <u>6.5</u>	5 ^{5.5} <u>4.5</u>	<u>11</u>
PASS	8 ^{8.5} <u>7.5</u>	5 ^{4.5} <u>5.5</u>	<u>13</u>
TOTAL	<u>14</u>	<u>10</u>	<u>24</u>

$$\chi^2 = 0.417$$

8

9.

RELATIONSHIP: FREE PROBLEM SOLVING/IDENTITY RECONSTRUCTION(2)

Total Old.

8 \ 9.	FAIL	PASS	TOTAL
FAIL	13 ^{12.5} <u>12.5</u>	11 ^{11.5} <u>11.5</u>	<u>24</u>
PASS	12 ^{12.5} <u>12.5</u>	12 ^{11.5} <u>11.5</u>	<u>24</u>
TOTAL	<u>25</u>	<u>23</u>	<u>48</u>

$$\chi^2 = 0$$

C

D

RELATIONSHIP: IDENTITY RECOGNITION/IDENTITY RECONSTRUCTION(1)

Old Girls/ $\frac{1}{2}$ Total

C \ D	FAIL	PASS	TOTAL
FAIL	9 ^{8.5} <u>8.5</u>	1 ^{1.5} <u>1.5</u>	10
PASS	7 ^{7.5} <u>7.5</u>	7 ^{6.5} <u>6.5</u>	14
TOTAL	16	8	24

$$\chi^2 = 0$$

C

D

RELATIONSHIP: IDENTITY RECOGNITION/IDENTITY RECONSTRUCTION(1)

Total Old.

C \ D	FAIL	PASS	TOTAL
FAIL	17 ^{16.5} <u>12.92</u>	3 ^{3.5} <u>7.08</u>	20
PASS	14 ^{14.5} <u>12.08</u>	14 ^{13.5} <u>9.92</u>	28
TOTAL	31	17	48

$$\chi^2 = 4.80.$$

C E

RELATIONSHIP: IDENTITY RECOGNITION/WHAT WOULD HAPPEN IF.

Old Girls/ $\frac{1}{2}$ Total

C \ E	FAIL	PASS	TOTAL
FAIL	5 ^{4.5} <u>3.5</u>	5 ^{5.5} <u>6.5</u>	10
PASS	3 ^{3.5} <u>4.5</u>	11 ^{10.5} <u>9.5</u>	14
TOTAL	8	16	24

$$\chi^2 = 0.0875.$$

RELATIONSHIP: IDENTITY RECOGNITION/WHAT WOULD HAPPEN IF.

Total Old.

C \ E	FAIL	PASS	TOTAL
FAIL	9 ^{8.5} <u>7.83</u>	11 ^{11.5} <u>12.9</u>	20
PASS	8 ^{8.5} <u>9.9</u>	20 ^{19.5} <u>18.83</u>	28
TOTAL	17	31	48

$$\chi^2 = 0.752.$$

C F

RELATIONSHIP: IDENTITY RECOGNITION/RECLASSIFICATION.

Old Girls/Total Old.

C \ F	FAIL	PASS	TOTAL
FAIL	7 ^{6.5} <u>6.5</u>	3 ^{3.5} <u>3.5</u>	10
PASS	7 ^{7.5} <u>7.5</u>	7 ^{6.5} <u>6.5</u>	14
TOTAL	14	10	24

$$\chi^2 = 0$$

C F

RELATIONSHIP: IDENTITY RECOGNITION/RECLASSIFICATION.

/Total Old.

C \ F	FAIL	PASS	TOTAL
FAIL	14 ^{13.5} <u>12.83</u>	6 ^{6.5} <u>7.7</u>	20
PASS	15 ^{15.5} <u>16.9</u>	13 ^{12.5} <u>11.83</u>	28
TOTAL	29	19	48

$$\chi^2 = 0.719.$$

D

E

RELATIONSHIP: IDENTITY RECONSTRUCTION/WHAT WOULD HAPPEN IF.

Old Girls/ $\frac{1}{2}$ Total.

D \ E	FAIL	PASS	TOTAL
FAIL	7 ^{6.5} <u>7.5</u>	9 ^{9.5} <u>8.5</u>	<u>16</u>
PASS	1 ^{1.5} <u>1.5</u>	7 ^{6.5} <u>6.5</u>	<u>8</u>
TOTAL	<u>8</u>	<u>16</u>	<u>24</u>

$$\chi^2 = 0$$

D

E

RELATIONSHIP: IDENTITY RECONSTRUCTION/WHAT WOULD HAPPEN IF.

Total Old.

D \ E	FAIL	PASS	TOTAL
FAIL	13 ^{12.5} <u>10.33</u>	18 ^{18.5} <u>20.66</u>	<u>31</u>
PASS	3 ^{3.5} <u>5.66</u>	14 ^{13.5} <u>11.33</u>	<u>17</u>
TOTAL	<u>16</u>	<u>32</u>	<u>48</u>

$$\chi^2 = 1.924$$

D

F

RELATIONSHIP: IDENTITY RECONSTRUCTION(1)/RECLASSIFICATION

Old Girls/ $\frac{1}{2}$ Total

D \ F	FAIL	PASS	TOTAL
FAIL	11 ^{10.5} 11.5	5 ^{5.5} 4.5	16
PASS	4 ^{4.5} 4.5	4 ^{3.5} 3.5	8
TOTAL	15	9	24

$$\chi^2 = 0$$

D

F.

RELATIONSHIP: IDENTITY RECONSTRUCTION (1)/Reclassification.

Total Old.

D \ F	FAIL	PASS	TOTAL
FAIL	21 ^{20.5} 19.4	10 ^{10.5} 11.6	31
PASS	9 ^{9.5} 10.6	8 ^{7.5} 6.4	17
TOTAL	30	18	48

$$\chi^2 = 0.55$$

D

G

RELATIONSHIP: IDENTITY RECONSTRUCTION(1)/IDENTITY RECONSTRUCTION (2)

Old Girls/1/2 Total.

D \ G	FAIL	PASS	TOTAL
FAIL	11 $\frac{10.5}{10.5}$	5 $\frac{5.5}{5.5}$	16
PASS	5 $\frac{5.5}{5.5}$	3 $\frac{2.5}{2.5}$	8
TOTAL	16	8	24

$$\chi^2 = 4.510$$

D

G

RELATIONSHIP: IDENTITY RECONSTRUCTION(1)IDENTITY RECONSTRUCTION (2)

Total Old.

D \ G	FAIL	PASS	TOTAL
FAIL	21 $\frac{20.5}{16.5}$	10 $\frac{10.5}{14.75}$	31
PASS	4 $\frac{4.5}{8.75}$	13 $\frac{12.5}{8.5}$	17
TOTAL	25	23	48

$$\chi^2 = 5.76$$

E

F

RELATIONSHIP: WHAT WOULD HAPPEN IF/RECLASSIFICATION.

Old Girls/ $\frac{1}{2}$ Total

E \ F	FAIL	PASS	TOTAL
FAIL	8 ^{7.5} <u>7.5</u>	0 ^{0.5} <u>1</u>	8
PASS	6 ^{6.6} <u>6.5</u>	10 ^{9.5} <u>8.5</u>	16
TOTAL	14	10	24

$$\chi^2 = 1.693.$$

E.

F.

RELATIONSHIP: WHAT WOULD HAPPEN IF/RECLASSIFICATION.

$\frac{1}{2}$ Total.

E \ F	FAIL	PASS	TOTAL
FAIL	13 ^{12.5} <u>9.9</u>	4 ^{4.5} <u>7.9</u>	17
PASS	15 ^{15.5} <u>18.9</u>	16 ^{15.5} <u>12.9</u>	31
TOTAL	28	20	48

$$\chi^2 = 2.501$$

E S

RELATIONSHIP: WHAT WOULD HAPPEN IF/IDENTITY RECONSTRUCTION(2)

Old Girls/ $\frac{1}{2}$ Total.

E \ S	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 32.5 \\ \hline 3.5 \end{array}$	$\begin{array}{r} 55.5 \\ \hline 4.5 \end{array}$	8
PASS	$\begin{array}{r} 11.5 \\ \hline 1.5 \end{array}$	$\begin{array}{r} 54.5 \\ \hline 6.5 \end{array}$	16
TOTAL	14	10	24

$$\chi^2 = 1.129$$

E S

RELATIONSHIP: WHAT WOULD HAPPEN IF/IDENTITY RECONSTRUCTION(2)

Total Old.

E \ S	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 87.5 \\ \hline 8.33 \end{array}$	$\begin{array}{r} 88.5 \\ \hline 7.66 \end{array}$	16
PASS	$\begin{array}{r} 17.5 \\ \hline 16.66 \end{array}$	$\begin{array}{r} 14.5 \\ \hline 15.33 \end{array}$	32
TOTAL	25	23	48

$$\chi^2 = 0.010$$

F G

RELATIONSHIP: RECLASSIFICATION/IDENTITY RECONSTRUCTION(2)

Old Girls/ $\frac{1}{2}$ Total.

F \ G	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 7^{6.5} \\ \hline 6.5 \end{array}$	$\begin{array}{r} 7^{7.5} \\ \hline 7.5 \end{array}$	<u>14</u>
PASS	$\begin{array}{r} 7^{7.5} \\ \hline 6.5 \end{array}$	$\begin{array}{r} 3^{2.5} \\ \hline 3.5 \end{array}$	<u>10</u>
TOTAL	<u>14</u>	<u>10</u>	<u>24</u>

$$\chi^2 = 0.0729.$$

F. G.

RELATIONSHIP: RECLASSIFICATION/IDENTITY RECONSTRUCTION(2)

Total Old.

F. \ G.	FAIL	PASS	TOTAL
FAIL	$\begin{array}{r} 13^{12.5} \\ \hline 15.11 \end{array}$	$\begin{array}{r} 16^{16.5} \\ \hline 13.89 \end{array}$	<u>29</u>
PASS	$\begin{array}{r} 12^{12.5} \\ \hline 9.89 \end{array}$	$\begin{array}{r} 7^{6.5} \\ \hline 9.11 \end{array}$	<u>19</u>
TOTAL	<u>25</u>	<u>23</u>	<u>48</u>

$$\chi^2 = 0.898.$$

INTERPRETATION OF RESULTS

Differences between Sexes and Age-Groups (see Set 1 Tables)

(all age-groups, i.e. Totals)

Sex

The results for the analysis of variance for each of the seven tests showed a very similar pattern in every case. The sex effect has no significance in any of the tests, that is to say there are no differences between the boys' and the girls' performances. This finding was not surprising, such a difference had not been hypothesised and was in no way anticipated. (Hopefully such a condition had no effect upon the outcome!) (Rosenthal, 1963).

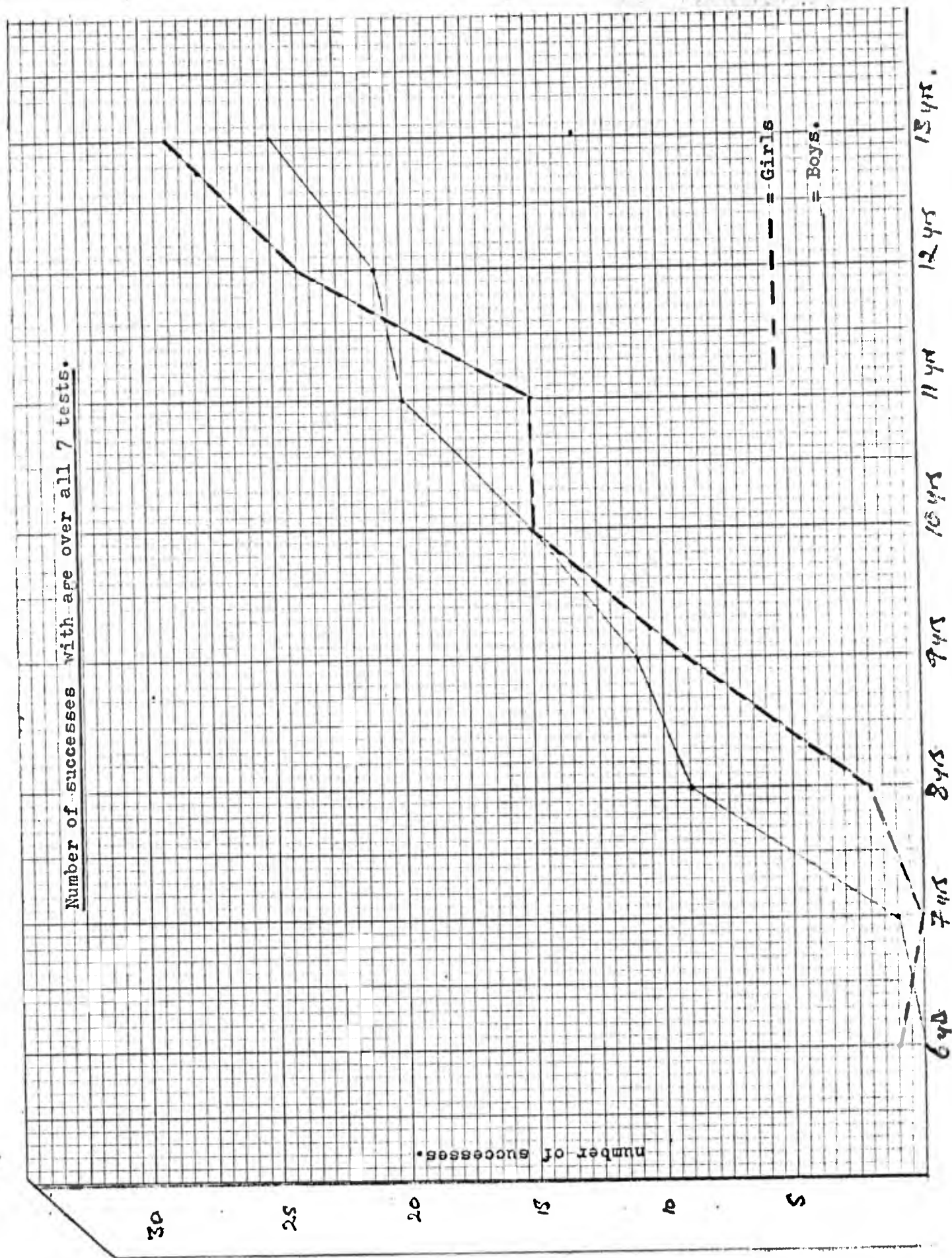
Age

The age effect is, as expected, highly significant in five out of seven tasks (i.e. above the 0.5% level). The other two tasks are significant beyond the 5% level. One of the two tasks - Identity Re-construction (1) shows a spread of successes over all ages but does not indicate a steady increase of success with age as do the other tasks. It should perhaps be noted that only 22 out of a possible 96 pupils passed this task.

Sex-Age Interaction

The sex-age interaction is also insignificant for all tests. It is, however, interesting to note that for all tests the pattern of development differs between the sexes with age (see graph, over page). The boys indicate an almost steady growth with age; the girls are slower starters but make more rapid progress once they begin to score. The girls do not start to succeed significantly until nine years of age, one year later than the boys, but by 12 and 13 years of age, their performance is better than that of the boys.

Rosenthal, R. (1963) "On the social psychology of the psychological experiment: the experimenter's hypothesis as unintended determinant", Amer. Scientist. Vol. 51, No. 2, pp 268-83.



COMMENT

Whilst differences in performance between the two sexes was not a central consideration in the study or in the analysis, the fact that there were no such significant differences is a contribution to the coherence of the battery of tasks, in that it would not seem to be weighted in favour of any one sex. The slight difference in the pattern of development between boys and girls could be worthy of consideration especially if an eventual aim is the construction of a scale of assessment for both boys and girls. It would, however, be premature to draw any firm conclusions without replication work.

The most important finding in this analysis is obviously the very significant improvement in performance with age. This was clearly anticipated. It is an expectation which is rooted in Piagetian theory and reflected in the tasks constructed. As a "pass/fail" mode of assessment (i.e. where interest is not with qualitative changes in performance over time, as assessed by the sub-categories), the battery would be best employed with subjects in the oldest age groups (11+ years), for younger subjects, though able to satisfy aspects of the various tasks (as illustrated by the sub-categories of assessment), are generally less able to score on a pass/fail assessment.

RELATIONSHIPS BETWEEN THE TASKS

This is clearly a central question in research which is attempting to re-define an area and to assess what has been re-defined.

a) Relationships between Totals (Set 2 Tables)

The overall total scores for each pair (21 pairs) of tests were tested for independence: H_0 - that the pairs are independent. The Test applied was a X^2 contingency test (one-tailed).

In all cases but two (Identity Re-construction (1) with Re-classification and Identity Re-construction (2) with Re-classification) significance was obtained at 5% level. At this stage, (i.e. without further research) it is not possible to give firm reasons for low correlations between these particular tasks. The following points could, however, be made:

- 1) The level of cognitive ability required for the Re-classification task might be different from that needed for the other two tasks.
- 2) The low correlations may be attributable to the fact that the tasks require refinement. They need not be a comment on the abilities required for the tasks or upon the relationships between such abilities.

The high correlations stemming from the total scores need, perhaps, to be interpreted with some caution. It will be noted (see subject profiles, Appendix III) that amongst the younger subjects there was a high non-response rate in the sense that younger subjects were unable to execute the tasks. This could obviously have implications for the nature of the relationships between the tasks.

However, given that the main hypothesis expected improvement with age, such "failure" is to be expected in the lower age-groups, and, as was seen in the analysis of performance with age, the age-effect is very significant (above the 0.5% level). This is clearly a battery of tasks which requires abilities not possessed by the younger age group, and their inability is consistent across the tasks, a point which is important in terms of the relationships between tasks.

b) Relationships between Tasks for Sexes (Set 3 Tables)

Having tested the total scores and having obtained a high degree of significance, relationships between the tasks for sexes were considered.

It was decided to exclude the youngest subjects from this part of the analysis (ages 6-9 years), for the number of actual passes was too small to make any statistical analysis efficient. The first step was to test the hypothesis that the older girls (10, 11, 12, 13 years) were not significantly different from the results one would expect to obtain if the boys and girls were gaining similar results.

Findings

The only significance was for pair: Identity Re-construction (1) with Identity Re-construction (2) ($X_2 = 4.5$ sig. at 5% level). It was concluded therefore that generally there was no significant difference between the boys and girls for the ages 10-13 years. Again, such a finding contributes to a coherence of the battery, in that the tasks would not seem to discriminate against either sex at any age.

c) Relationships between Tasks for Older Subjects: 10-13 Years Inclusive (Set 3 Tables)

The second step was to test for independence between all tasks for all subjects aged 10 to 13 years inclusive (i.e. 48 subjects - 24 boys, 24 girls). The only comparisons giving significant results were as follows:

Tasks Showing Dependence for the 10-13 Year Age-Group		
Relationship	X_2	Significance Level
Elaboration/Identity Re-construction (1)	8.55	1%
Free Problem Solving/Identity Re-construction (1)	5.83	5%
Free Problem Solving/Re-classification	17.08	1%
Identity Recognition/Identity Re-construction	4.80	5%
Identity Re-construction (1)/Identity Re-construction (2)	5.75	5%

The second analysis of task inter-dependence raises some interesting questions, the obvious conclusion being that 16 test-pairs would appear to be independent. It is interesting to notice that 4 out of 6 of the pairs involving Identity Re-construction (1) show association and that only one out of the remaining 15 do so. It seems that Identity Re-construction (1) is associated rather generally with an otherwise independent set of tests, in this age-band. These findings, when viewed in relation to the first finding on task association, lead to the following comments:

1) In this analysis, the tasks are being scored on a pass/fail basis. The battery of tasks is not standardised for any one age-group, but is expected to be most suited to the upper age ranges (perhaps beyond the scope of this sample), for complete success on the tasks requires formal operational ability. It is to be expected, therefore, that the developmental response pattern to the battery would be:

- (a) failure,
- (b) a mixture of passing and failing, and finally,
- (c) success for the most part.

The upper age group in the total sample (10-13 years inclusive) are possibly in a transitional stage in terms of their ability to respond to the tasks (i.e. in section (b) of the response pattern). This condition may well explain the findings of low task association in all except five pairs of tasks for the 10-13 years age group, especially in view of the high task association found for the whole sample.

2) There is a need to administer this same battery of tasks to an older age group (i.e. 13+ years). In the initial planning of this research, the present age-bands were chosen, for the development of creative ability was believed to parallel that of normative cognitive development. However, given that creative ability is believed to be dependent upon normative cognitive ability, it may be that stages of creative ability do not

exactly parallel those of normative cognitive ability, but appear slightly later. In which case, subjects in the 10-13 year old group would not have attained the stage of 'formal' creative ability and would be unsteady and inconsistent in their responses, as is typical of persons in a state of stage-transition.

- 3) It is perhaps important to note that the analysis of only the upper half of the age group reduced the initial sample by half (from 96 to 48). If a larger sample had been involved in this particular set of analysis, it is possible that all cells of the contingency tables would have had values greater than or equal to 5. This could make the tests more efficient. It has been noted (e.g. McCall, 1970) that small values in a X^2 test tend to make the test conservative in accepting the null hypothesis. It is conceivable that larger samples could detect relationships more readily, but most likely only in those cases for which the calculated X^2 is 'close' to the tabulated (5% significant) value. In a number of cases here, the value was less than 1, and in these cases no major alteration, due to increased sample size, would be expected.
- 4) It is possible that inaccuracies in scoring could explain some of the task independence for this age group though serious weighting is not given to this explanation. As noted, subjects in this age-group are likely to be in a transitional stage of creative ability and responses of such subjects are not always easy to classify.

Comment

Though replication work is required, and whilst there is a need to administer the battery to an older age-group of subjects, it is believed that the analysis so far reflects task inter-dependence and not independence. This is argued because the battery is clearly intended for older subjects and failure in the youngest age range, followed by uncertain responses in a transitional stage are the obvious theoretical precursors to success.

However, this assessment has been two-fold:

- a) it has operated on a pass/fail basis; and
- b) by means of the sub-categories, it has attempted to note the improvement in subjects with age. An analysis of the sub-categories is therefore called for and follows later in this section. The Graphs presented in Chapter 6 also indicated improvement in performance on the different sub-categories of each task.

Interdependence of Transformations: Theoretical Support

Creativity is not about accrued knowledge. Information and experience do not in themselves constitute creative ability. Creativity involves the ability to re-conceive of phenomena. It requires therefore the ability to conceptualise.

Thought can be examined in terms of content and process and form. This research is primarily interested in form. Elaboration and addition are examples of different forms of thinking. They lead to different transformations of reality.

Progress in any one form would appear to develop with age and experience. According to one's experiences the openings, the fields for re-conceptions of reality will expand and vary. This is a content matter.

Thought processes therefore have various forms and can operate upon different content.

A process is a complete event; it has a starting point and a terminal point and phases or levels between. Theoretically, the mature thinker is capable of completing a thought process. Younger subjects are more likely to manage only certain levels of any one process.

This study has attempted to examine these processes of transformations of reality. It has attempted, in an exploratory way, by means of the sub-categories of assessment, to establish and define different aspects or levels of any one of the processes. Through training schedules, it has attempted to better understand the transitions from one aspect or level of a process to another.

Inter-relation of Processes.

All processes have the same starting point: the initial apprehension and construction of reality. Processes of transformation re-structure or modify these initial conceptions in some way. Theoretically, such processes must inter-relate, must result, empirically in test inter-dependence. Each process requires the same abilities: those of conception, re-conception, ability to anticipate, to grasp implications and ultimately to manage this without concrete props.

The sub-categories of any one process are ways of describing that process and the individual's performance on it. Such categories are context-specific in that they relate largely if not solely to that one process, though not solely to a particular context or medium.

A further question is - what is the inter-relationship, if any, in terms of sub-categories across processes? To answer this question a further step is required - the generation of less context-specific categories. After consideration of the findings in part one of this research, more general categories might be, e.g.:

Principle	Level of Transformation		
e.g. ELABORATION	1. Re-apprehension	2. Deliberate Transformation (concrete)	3. Deliberate Transformation (formal)

This is not a firm proposal simply an indication of future direction, and an attempt to find common (i.e. inter-task) levels along a continuum of increasing cognitive organisation. Examination by correlational techniques would be important. It would provide assurance and direction, given that one returned to the theory.

This is the essence of the proposal for a scale of operational creative ability to be outlined in the final chapter.

Separation of Content and Form

According to familiarity with/skill in a particular medium, so one can operate upon that content (Cf. 'd  calage'). Distinctions must be made therefore between assessment of a process in itself (i.e. where skill or knowledge requirement is low) - and application of that same process in a knowledge laden context. For different reasons both are valid.

An individual who actively understands the process of division should, theoretically, always succeed on tasks of such which do not require special skill or knowledge in a given area.

Where he is expected to apply that same process in a knowledge laden context then understanding of the context must be taken into consideration.

Given that such distinctions are made, theoretically these processes of transformation of reality must inter-relate. Between the theory and the final correlational verification is a problematic empirical process of accurately establishing levels of accomplishment of processes. The starting point is zero - the terminal point must be complete success - the search for clearer identification of the intermediary levels continues. Similarly, the search for tasks which adequately reflect these levels goes on. When replication work contributes to confidence in these areas, statistical analysis could provide firmer assurances and clearer directions.

The Concept of Stage in relation to the Analysis

It would be highly premature at this stage of the research to come to other than very tentative conclusions about a stage explanation of creative ability, though the concept of such is upheld at the theoretical level. An initial main question is: "What kinds of responses (if any) are characteristic of which age groups?"

There was no attempt to develop a set of tasks to represent each stage. It is not the tasks which are believed to characterise stages of ability, but the ways in which the tasks are interpreted and handled. Accordingly, one set of tasks was developed and an attempt was made to establish qualitative categories of assessment (sub-categories) which would give some indication of changes in degree of cognitive organisation.

In analysis of the sub-categories, comparison across tasks is not always possible. It is too early yet to say that any one sub-category (e.g. "an organised response") speaks of the same or equivalent degree of cognitive organisation across tasks. Whilst sub-categories avoid being context-specific in terms of being tied to a particular medium, they are still more ordinal than interval in nature (Appendix IV).

Bearing such limitations in mind, and aware of the need for replication work and for further consideration and refinement of the sub-categories, some analysis was made, but of a descriptive rather than an inferential nature.

The system adopted was to grade the standard achieved by the sample (of 12 in any one age group) according to the dominant standard of response. The standards were set out as follows:

1. disorganised response
2. disorganised/partly organised response
3. partly organised response
4. partly/fully organised response
5. organised response

It should be noted that not all tasks were suitable for this consideration - only those which had a threefold response classification based on increasing organisation. Tasks examined were:

Free problem solving (Part 2 of Task)

Identify Re-construction (1) (both parts of task)

What Would Happen If Task

Identity Re-construction (2) (Part 1 of Task)

The procedure for each test was to take each age in turn and associate it with one of the five grades of achievement given above. The five tasks concerned fall into two broad types by the pattern of development of the sample:

Group 1: Tasks - Identity Re-construction (1) (Part 1)
Identity Re-construction (2) (Part 1)
 (identical pattern for each task)

<u>Grade of Achievement</u>	<u>Ages</u>
1	6 and 7 years
2	8 and 9 years
3	10 years
4	11, 12 and 13 years
5	-

Group 2: Tasks - Free Problem Solving (A), Identity Re-construction (1)
 Part 2 (B), What Would Happen If (C)

<u>Grade of Achievement</u>	<u>Ages</u>		
	<u>A</u>	<u>B</u>	<u>C</u>
1	6,7,8	6,7,8	6,7,8
2	9,10,11	9,10	9,10,11
3	12	11,12	-
4	13	13	12
5	-	-	-

Piaget, in his explanation of the development of intelligence, has never attempted to tie stages to specific ages, but has associated them with age-bands. Further, definite criteria for the identification of stages have been laid down (Tanner, J. and Inhelder, B. (1956)). Two important observations, related to these criteria, emerge from the current exercise:

- a) There is a pattern of increasing cognitive organisation described and classified here by a threefold category assessment.
- b) Assessment sub-categories are certainly hierarchical and irreversible (according to the ages associated with the different qualitative responses).

In addition, there is the possibility that different qualitative responses might be associated with age bands as follows:

Response	Age	Stage
1. Disorganised responses	6,7,8 years	autistic transformations
2. Partly disorganised }	9,10,11,12 years	concrete transformations
3. Partly organised		
4. Partly/fully organised }	12,13,14 years	formal transformations
5. Fully organised response		

A problem requiring more investigation is whether progress is best described by stage or whether it is more a matter of continuous development. A closer examination (in replication studies) of the scoring method would be required here to decide whether responses could fall firmly into clear stage-categories or whether there were too many exceptions straddling categories, thus breaking down the stage-explanation of creative ability.

Theoretically, a stage explanation should hold, because of the close relationship between creative and intelligent abilities.

One point of interest is that if there is a stage explanation of creative ability, it may have a slower development rate than that of intelligence. The age associations would seem to suggest this. Given that creative ability is argued to be dependent upon intelligence this is to be expected.

In concluding this sub-section, it could be mentioned that apart from suggesting a way to a stage-explanation of creative ability, the sub-categories are important in describing the progress of individuals through any one task. Apart from offering an explanation of an individual's behaviour, the graphs representing sub-category responses (Chapter 6) suggest that such responses form a general developmental pattern. Such qualitative descriptions are of value both in assessment, where the intention is to understand the nature of the response, and in training attempts, where transitional points in attainment are normally of interest.

GENERAL CONCLUSIONS

1. It would seem reasonable to conclude (in the light of the theory and the findings) that the tasks in the battery are inter-dependent. The lack of such inter-dependence in the upper age-groups may be explained by the belief that this group is transitional - falling between two stages of ability - thus giving inconsistent, and unpredictable responses.
2. There is a clear increase in ability to perform on the tasks with age. This was anticipated and suggests that the battery will be most suited to the older age range when it is being employed on a pass/fail basis. However, when levels or degrees of success rather than actual passes are being examined then, by use of the sub-categories of assessment, this battery could be a useful tool in the assessment of developing ability.
3. There were no significant differences in performance between the boys and the girls. This was not anticipated and is not a serious consideration of the underpinning theory.
4. There is the possibility, based on assessment by the sub-categories, of a stage explanation of creative ability. There are indications of a hierarchy of ability and of irreversibility, but further refinement of the sub-categories is required in order to better examine "borderline" responses which appear to straddle categories, thus weakening the stage explanation in favour of a pattern of continuous development of creative ability.

PART TWO

Chapter 8

TRAINING AND CREATIVE ABILITIES

A CONSIDERATION OF THE LITERATURE

In this section creative ability and the effects of training are considered, in an attempt to understand more fully the problems of apprehension and interpretation of reality. The section begins with a review of literature in this area.



Any kind of training scheme has to be understood in the light of the theoretical standpoint supporting it. The concern of this study is not really with learning-theory approaches stemming from the old empiricist tradition, which assumes that the child acquires what is being taught as a function of repeated external reinforcements. Neither is it interested in theories which are based upon the idea that development is about the maturation of the nervous system and not about experience. Its concern is with that Piagetian approach which asserts that logical structures are not originally present in the child's thinking but come about through the process of equilibration.

Concepts of learning are based upon different notions of man and man's knowing. There are those explanations which give freedom to man in that he is seen as an active construer of reality (Kelly, 1963) and others which speak in terms of external, environmental contingencies (Skinner, 1972). Opposing schools tend somewhat to caricature their opponents regarding them as guilty of solipsism on the one hand, or production-line moulding on the other.

Skinner (1972) argues that behaviour is "shaped and maintained by its consequences". He believes that recognition of this fact will make possible the formulation of interaction between the organism and the environment in a more comprehensive way. Whilst he argues in what Kelly has termed the 'language of objects' (Kelly, 1963), there is a place in his theory for originality (1965):

We reserve the term original for those ideas which result from manipulations of variables which have not followed rigid formula and in which the ideas have other sources of strength... We may therefore acknowledge the emergence of novel ideas, in the sense

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- Kelly, G. (1963) A Theory of Personality: The Psychology of Personal Constructs.
 Skinner, B.F. (1972) Beyond Freedom and Dignity.
 Skinner, B.F. (1965) Science and Human Behaviour. P.254.

of responses never made before under the same circumstances, without implying any element of originality in the individuals who have them."

As might be expected the reasons for originality are placed firmly outside of the individual, and attainment is equally an external process:

"Reinforcing contingencies shape the behaviour of the individual, and novel contingencies generate novel forms of behaviour. Here, if anywhere, originality is to be found." (Ibid)

Given that Skinner sees control of contingencies as important - one might ask how - if creativity is explained in terms of being external to the individual - any individual can (a) manipulate contingencies for creative outcomes, (b) recognise outcomes as novel? In the last analysis, it would seem to be an 'inside' question, if only because it implies evaluation.

A very 'inside' explanation is offered by George Kelly (1963). 'Outside language' is wholly rejected:

"... it is not what happens around him that makes a man experienced; it is the successive construing and re-construing of what happens."

Prime place is given to man as a construer of reality, and notions such as motivation and learning 'evaporate' (1970). In a certain sense, much of Kelly's theory is about 'novelty' in that each construct has its own uniqueness. However his commonality corollary provides a shared core of constructs against which one could assess deviance or novelty.

Salmon (1970) reviewing explanations of growth, points to shared factors in the explanations of Kelly and Piaget. Both adopt a point of view which is internalised; both stress the importance of organisational factors and in both theories, change is described in structural terms. But there is a fundamental difference:

Skinner, B.F. (1972) Ibid. P.255.

Kelly, G. (1963) A Theory of Personality: The Psychology of Personal Constructs. P.73.

Kelly, G. (1970) "A brief introduction to personal construct theory", In: Bannister, D. Perspectives in Personal Construct Theory. P.29.

Salmon, P. (1970) "A psychology of personal growth", In: Bannister, Ibid.

"Piaget's theoretical account rests upon an absolutist view of truth... This view runs counter to the philosophical basis of construct theory, whereby reality can never be known in any final, absolute way, but only through our constructions, which as a result of the varying validation outcomes of the behavioural experiments we make are subject to continual revision." P.214.

Kelly's theory is not of course concerned with developmental aspects of a construct system and he is not therefore obliged, as is Piaget, to provide genetic explanations. Further, concerning the matter of Piaget's theoretical account, much depends on what absolutism implies. Kelly does not deny commonality any more than Piaget's explanation denies the possibility of novel constructions of reality. It is true that Piaget's interest is more squarely in the area of normative constructions of reality, and that he regards such constructions as 'objective', such an admission, however, does not rule out the possibility or existence of other constructions. Indeed, if there are to be novel constructions there must be more common constructions against which to measure novelty. In this sense Piaget provides a starting point for creative re-structurings.

All training attempts to look at behaviour under a theoretical microscope. The behaviourally inspired will seek out minute and detailed connections, examining sets of conditions for learning (Gagné, 1970). Piagetians will be concerned to note, in an equally detailed way, the various mechanisms of transition from one level of development to another (Sinclair, 1974; Miller and Heldmeyer, 1975). Most schools give importance in some way to validation or reinforcement. Kelly speaks of validation, Skinner of reinforcement. Even the Piagetian child must receive some form of assurance or validation when he is impressed by the logic of necessity. Without such he would hardly be aware of the logic involved.

Salmon, P. (1970) Ibid. P.214.

Gagné, R. (1970) The Conditions of Learning.

Miller, P. and Heldmeyer, K. (1975) "Perceptual information in conservation: effects of screening". Ch. Devt. 46. pp 588-92.

Piaget himself was not concerned with questions of 'training' - an American issue which he left to Bruner; and yet his standpoint has tempted many investigators to look at the role of 'experience' and the possibility of 'training' to accelerate the formation of these logical structures. Immediately one is led to ask - "what is experience?". How does one trap an experience which is meaningful to a given individual - in the sense that it will challenge his structures and bring about re-organisation and expansion? When one examines Piaget's theory of knowledge, of knowing - it becomes yet more problematic, because he does not conceive of knowing in a cumulative sense, his postulates are rather about the construction and re-construction of reality. The formation of a structure, whilst a possibility within a theoretical explanation, is difficult to submit to empirical investigation, though its presence or absence can well be inferred (Sinclair, 1974)

Piaget himself gives a lead on what is to be looked for in such investigations (1972). He begins by making a distinction between learning and development. Development, as he conceives of it, is tied to the whole process of embryogenesis, which concerns the development of the body as well as the development of the nervous system and mental functions. Learning on the other hand is seen as being provoked by specific situations. Further, Piaget sees learning as a limited process in that it is tied to a single problem or to a single structure (Piaget, 1972, *ibid*). Development cannot be explained in terms of a sum of discrete learning experiences.

Sinclair, H. "Recent Piagetian research", in: Piaget in the Classroom, Raph, J. and Schwebel, M. (eds) (1973).

Piaget, J. "Development and learning", in: Readings in Child Behaviour & Development. Lavatelli, C & Stendler, F (Eds) 1972. P. 8.

However, as mentioned earlier in Chapter 2, there is an experience - a particular quality of experience which might be 'open to manipulation' and Piaget defines this quality of experience. He makes a distinction offering two types of experience:

"Physical experience consists of acting upon objects and drawing some knowledge about the objects by abstraction from the objects."

This is one kind of experience and very accessible to experimentation. However, there is a further type, more transforming in terms of logical structures and more sought after in terms of experimentation:

"... there is a second type of experience which I shall call logical mathematical experience where the knowledge is not drawn from the objects, but it is drawn by the actions effected upon the objects... It is an experience of the actions of the subject, and not an experience of the objects themselves . It is an experience which is necessary before there can be operations."

Clearly, this kind of experience is available in different amounts and areas in different cultures. Cultural variations on Piagetian type tasks suggest that certain kinds of experiences can be lacking in particular cultures, thus hindering the formation of particular logical operations. There are numerous instances to support this, but that of Marks Greenfield in Senegal will suffice for the moment. Similarly, within a given culture there are variations. Different children move through Piaget's stages at different ages. Exposure to the same 'experiences' is no guarantee that there will be uniform transformation of structures within any one age group. And so once again, the crucial question is - how does one invent, structure for, an experience which will affect the cognitive structures of a child, and in so doing discover something of what happens to a child when experience, in this specific Piagetian sense, becomes "meaningful"?

Piaget, J. (1972) Ibid. P.41.

Greenfield, P.M. (1966) "On culture and conservation" in: Studies in Cognitive Growth, Bruner et al. (eds).

Such was the question put by Kingsley & Hall in a training attempt based on Gagné's idea of learning sets. Having evaluated previous research attempts in the area they go on to point out that:

"....(we) would offer an alternative hypothesis for the training failures emphasising experiential rather than internal variables. We would contend that most of the training attempts referred to above have ignored the large amount of background knowledge necessary and thus time needed to train children for conservation mastery."

Their own efforts obviously attempted to put into operation what other failed to do. Their effort was based on Gagné's approach which divides the material to be taught into a hierarchy of sub-tasks. Like Smedslund (1961) before them, they added a further check - an extinction task. With Smedslund they found that subjects who had been "trained to conserve" failed to resist extinction (only 3 on 17 could resist). Smedslund points out that this is consistent with equilibration theory. It should be pointed out, however, that in Kingsley and Hall's work even the 'natural conservers' failed to resist extinction. A Piagetian reply could well be that their structures were not well founded, that they were on the brink of attainment but still in formation.

Piaget has his own comment to make on such attempts.

"... he (Smedslund) was successful in obtaining learning of what I called earlier, physical experience (this is not surprising, it is simply a question of noting facts about objects), but he was not successful in obtaining learning in the construction of the logical structure. This doesn't surprise me either, since the logical structure is not the result of physical experience. The logical structure is reached only through internal equilibration..." Piaget, 1972.

Kingsley, R.C. and Hall, V.C. "Training conservation through the use of learning sets", Child Devt. 38 (1967) pp 1111-26.

Smedslund, J. (1968) "The acquisition of conservation of substance and weight in children", in: Logical Thinking in Children, Sigel, I. and Hooper, F. (eds)

Piaget, J. (1972) "Development and learning", in: Readings in Child Behaviour & Development, Lavatelli. C. & Stendler. F.(Eds). P. 44.

The attempt by Kingsley and Hall is reminiscent of some of the philosophy of Jerome Bruner with his concern to act as a "translator" - a person who can digest information and pass it on in a mode which will be readily understandable to those who as yet can only represent their world in certain modes. His ideas and practices are not, however, always confined to a controlled experimental situation but addressed more widely to "agents of culture" - such as teachers:

"... by giving the child multiple embodiments of the same general idea expressed in a common notation, we lead him to 'empty' the concept of specific sensory properties until he is able to grasp its abstract properties..." (See PLATE 54)

The basic idea is always the same - how does one accelerate the movement of the child's cognitive development - what props, supports does one employ until somehow the 'logic of necessity' takes over (Piaget, 1972).

Wood and Middleton (1975) attempted a form of training which is in fact shot through with Piagetian clinical techniques. Working with 12 mothers and their children, they described their approach as assisted problem solving. After assessing attempts on a toy-like, block construction set, they concluded that:

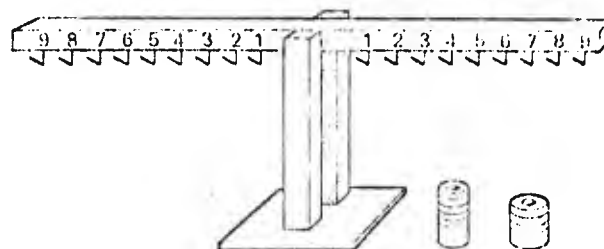
"...those mothers who systematically changed their instructions on the basis of the child's response to certain interventions... were most likely to see their child perform effectively after instruction... effective instructing is a dynamic, interactive process somewhat akin to problem solving."

Gagné (1964) regarding problem-solving as a form of learning in itself, points out a number of problems regarding the measurement of problem solving performance. In problem solving, as Gagné indicates, time could

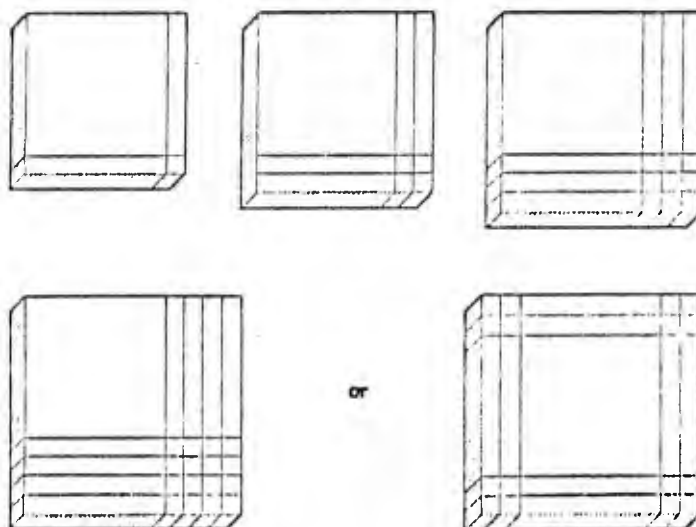
Bruner, J. (1968) Towards a Theory of Instruction

Wood, D. and Middleton, D. (1975) "A study of assisted problem solving", B.J. Psy. 66, pp 181-91.

From: Representation and Mathematics Learning by Bruner. J.S.
and Kenney. H.J.



Balance beam and rings used on quadratic construction.



Squares of ever increasing size constructed with components.

PLATE 54

"The problem sequences were designed to provide, first, an appreciation of mathematical ideas through concrete constructions using materials of various kinds for these constructions. From such constructions the child was encouraged to form perceptual images of the mathematical idea in terms of the forms that had been constructed. The child was then further encouraged to develop or adopt a notation to describe his construction. After such a cycle, a child moved on to the construction of a further embodiment of the idea on which he was working, one that was mathematically isomorphic with what he had learned although expressed in different materials and with altered appearance."

not be regarded as an adequate measure, neither could the number of presentations. In research concerned with qualitative dimensions of performance, Gagné points out that:

"Much depends upon the degree to which the subject's responses are limited or controlled by the problem situation. Where there is some degree of control, kinds of errors might be a useful criterion as the structure of the situation will mean that these errors will be made by a number of subjects as opposed to each subject making their own errors." (1964)

Hermina Sinclair (1974) has made attempts to approach training in interactive terms, though the intention was not to train or to accelerate for the sake of such, but to learn more about transitions from one sub-stage to another. Summarising the research conclusions of the work carried out by the Centre d'Epistemologie in Geneva in the 1960s, Sinclair concludes that:

"Empirical methods whereby the subject has to accept a link between events because this link is imposed upon him, do not result in progress; progress results when the subject discovers the link." P.57

Sinclair, expanding this idea in relation to these and her own research points out that:

"... in situations specifically constructed so that the subject has active encounters with environment - the same mechanisms as in development are at work to make for progress..." P.58

Essentially, therefore, learning situations of the type acceptable to Piagetians must be microcosms of what might be termed 'normal development' and because such development takes place in a variety of contexts and manners, and at different speeds, there can be little standardisation of such 'microcosms of development'.

Gagné, R. (1964) "Problem solving", in: Categories of Human Learning. Melton, A.W.

Sinclair, H. (1974) "Recent Piagetian research in learning studies", in: Piaget in the Classroom.

Whilst one intention of much training research is to enable subjects to come to terms with logics which were incomprehensible on pre-test runs, paradoxically, the very research attempts and 'translations' (in the Brunerian sense) might prevent the subjects from facing the challenge of the situation, and instead they may be faced with easy short-cuts to the issues, which is hardly the same thing. Whilst a Brunerian subject might well cope with formal concepts in concrete terms and expressions, he is still not coping formally. Sinclair (1974), presenting a conservation of length problem by means of matchsticks (discontinuous quantities or units as opposed to continuous quantities - such as string) notes:

"Using matches of equal length means that the experimenter has already solved part of the problem for the child, who can now simply discard his intuitive solution." P.62.

Such must be a hazard of attempting to discover something about the mechanisms of development in microcosm.

The problem is reflected in a number of research efforts, usually stemming from the actual attempt to make the logic more obvious to the child. Frank's screening procedure was an attempt to expose the logic of the problem to the child by removing distracting perceptual information. The test, of course, was what happened (or rather, did not happen) when subjects next faced the conservation of liquid problem in its classical form. Where research provides 'props' for subjects, it cannot be said that any real development of structures has taken place. What such research does do is to help explain some of the blocks and problems encountered by the young subjects. Real development of structures sets in motion a process which leads to further and different

Sinclair, H. (1974) Ibid.

Frank, F. (1966) cited in: Bruner, J. et al, Studies in Cognitive Growth. pp 193-4.

conclusions on the basis of the first conclusion. Eleanor Duckworth (1973) considering the relationship between language and knowing, and knowing as expressed through language, says:

"... if we really understand what we have been told, we make new connections for ourselves. We are now the masters of these new connections and can express them our own way (my underlining)." P.136.

More hope lies perhaps for observing the development of structures, in research attempts which, instead of "translating problems to a manageable size, attempt to make subjects participate very actively. Greenfield (1966), already mentioned, has made this type of attempt. She concluded that the extent to which subjects were allowed to take an active part in the experimental situation would affect their grasp of conservation. It should be pointed out that this method was 'successful' with only one group of subjects - unschooled Wolof children in Senegal. The other group - exposed to Western schooling - was not aided by this active participation.

Soenstroem (1966) looked at two major factors in training procedures: the effect of active manipulation of materials and the effect of labelling the shapes produced. She concluded that together, manipulation and language could take a stand against the force of appearance.

Training can concern itself with two dimensions:

1. with the development of structures or the acceleration of that development;
2. with fluency - which tends to assume the presence of abilities fundamental to the task in hand and which is concerned with output in terms of facility, ease, speed, etc.

Duckworth, E. (1973) "Constructing what we know" in: Raph, J. and Schwebel, M. (Ibid) P. 136.

Greenfield, P.M. (1966) "On culture and conservation" in: Bruner et al, Ibid.
Soenstroem, A.M. "On the conservation of solids" in: Bruner et al, Ibid.

The studies reviewed so far have been concerned largely with the first dimension and, interestingly, very few, if any researchers of creativity have applied this approach in their attempts to facilitate creativity (which varies widely in definition). It is believed that this has been so because no adequate explanation of the relationship between intelligence and creativity has been proposed. If it is held that creative ability is rooted in the same operational structures as is intelligence, then training for creative behaviour must concern itself with both dimensions - namely with the establishment of the necessary structures and with fluency training at the appropriate operational level. The lack of developmental studies of the relationship between intelligence and creativity may be a further reason why training in creativity has for the most part confined itself to older subjects, allowing one to assume, no doubt, the existence of basic abilities. The following studies, as will be seen, are interested mainly in what might be termed 'personality dimensions' of creativity. Cognitive blocks are less frequently scrutinised and hardly ever explained in terms of cognitive structures - or their absence.

Brainstorming - introduced by Osborn (1953) - is a method which is largely if not wholly concerned with the fluency dimension of training. Brainstorming attempts to overcome some of the 'inhibitions' or 'sets' which individuals develop over a period of time. It aims to facilitate the expression of the pre-conscious imagination in a group situation and this is done largely by deferring conscious evaluation. This, of course, is a method which rests on the assumption that individuals have the necessary cognitive structures to generate 'other' concepts of reality. It consists largely of abandoning constraints which hinder such generation. Much depends also upon the concept of "creative" behind such training sessions. If creativity is to be defined in, say, associational terms,

with scores translated into "statistical uniqueness" then one has no qualitative measure of what is being generated.

This is not to undervalue such techniques as brainstorming, but simply to stress that a more valuable approach might be to:

1. establish the structural operational abilities of subjects;
2. on the basis of such abilities train subjects in fluency according to his/her level of ability.

In other words, if it is possible to train to accelerate the development of structures, the techniques required must surely be very different from those concerned with fluency. That such fluency techniques are required is no doubt true. In this present study, it was noted that whilst subjects in the 12 and 13 year old age groups had the ability to conceive of hypothetical systems, to elaborate and identify in such tasks, they became increasingly embarrassed and inhibited about doing so. By contrast, younger subjects usually less self and less rule-conscious, would more easily elaborate on stimulus-lines and identify shapes and objects from further stimulus lines - less concerned that the identifications were not wholly accurate or that their system was 'silly'. The place of fluency testing and training is therefore stressed, but it must follow the establishment of operational structures if it is to be truly concerned with fluency, for even brainstorming involves evaluation of one's efforts - though it is deferred evaluation.

Interpreting Osborn (1953), what might be described as "tension" with regard to the nurture of creativity comes out clearly. It is best expressed when he deals with factors tending to hinder creativity. As

pointed out earlier much work on creativity has dealt with older subjects, subjects who would have developed particular sets, outlooks, perceptual expectations - "einstellung" or whatever. Literature, dealing with such 'problems', tends almost to "blame" experiences which have contributed to the formation of cultural logic because they would seem to hinder creative logics. Such comment is based - implicitly or otherwise - on a dichotomous approach to what is referred to as the creativity-intelligence split. It argues for one at the cost of the other, whereas in fact, creative logics are dependent by definition upon cultural logics.

Osborn (1953) takes up this discussion:

"Our thinking is mainly twofold: 1) a judicial mind which analyses compares and chooses; 2) a creative mind which visualises, foresees and generates.... As a result of education and experience we develop inhibitions which tend to rigidize our thinking." P.39.

He goes on to point out that Torrance (Guiding Creative Talent) has confirmed the fact that imagination tends to contract in proportion as knowledge and judgement expand. His concern therefore (i.e. Osborn's) is to "de-condition" subjects - remove factors which tend to block creative output.

This dichotomy exists, I suggest, because a consistent developmental approach to creative output has not been applied. Osborn, Rogers and others, anxious to facilitate creative output are right to be concerned about rigidity, but they need to consider 'flexibility and fluency' in its wider context of intelligence. A programme of training (developmental) could best be carried out on the following paradigm:

A first step would be to establish the operational level of the subjects with regard to the task(s) in hand.

Osborn, A.F. (1953) Ibid.

Torrance, E.P. (1962) Guiding Creative Talent.

Experiences might then be used to:

- a) bring the subject to a particular operational level more rapidly;
- b) establish the subject more firmly at a particular operational level.

"Creative training" aims essentially to deepen a subject's knowing of a particular identity (or identities) or his knowing of identities in relation. This increased knowing is rooted in his basic knowing.

Creative training would next seek to:

Increase flexibility/fluency in the application of such knowledge by:

- a) increasing the child's awareness of possibilities;
- b) increasing the child's awareness of the actual processes of the transformation involved, and of his own knowing in that process;
- c) increasing his awareness of implications of his actions upon identities and identities in relation;
- d) increasing his flexibility in his apprehension of an identity or identities in relation;
- e) increasing his output of interpretations of that reality.

"Fluency" training of the type employed by Osborn, is inappropriate without a certain level of cognitive development. Because we do not really know empirically how "equilibration" comes about, and because we cannot always be around when a meaningful experience in the Piagetian sense confronts a child and transforms his structures in a somewhat mysterious manner, it is difficult to construct experiences of the first type - i.e. those accelerating structures. In another theoretical context it is rather like watching 'insight' at work and this is just as elusive as equilibration. From current observations of training attempts with individual children certain points are to be made:

1. Work concerned to accelerate structures, training based on logico-mathematical experiences must have a largely clinical and therefore individual approach, following the logic and thought of a particular subject at a particular point in time.
2. Given the above, it may well be possible to discover from the child the experiences he needs in order to grasp the logic before him. This would not simply be about noting facts.
3. Fluency training, in the sense just described, is possible at the operational level of the child concerned. Little would be achieved at any higher level.

In Osborn's fluency training there are two fundamental principles which he describes as "the essence of procedure called brainstorming" (ibid)

- a) deferment of judgement;
- b) striving for quantity with regard to production of ideas.

Evaluation follows later.

The process requires therefore that subjects be capable of judgement and of evaluation of their ideas, though at some later point.

The striving for increased output is a deliberate process, and Osborn cites Parnes to explain how such processes can be stimulated.

Parnes likens the mind to a kaleidoscope:

"...if you manipulate you get countless patterns - ideas produced by combination and re-combination of existing elements... add a new fact or experience... and you add one new pattern. However, as soon as you begin to manipulate, combining and re-arranging the new fact with the old, you get an even greater number of new possible patterns of ideas." P.113. Ibid.

The concern of brainstorming then is to remove any barrier, cognitive or emotional, in order to increase output of ideas with a view to evaluation of these later.

Not all creative training programmes are group-based in the Osborn sense. Charles Whiting produced the idea of a technique named - "forced relationship technique" which he defined as:

"A technique for inducing original ideas which rely upon the creation of a forced relationship between two or more normally unrelated products or ideas as the starting point for the idea generation process." P.213.

An instance of this method would involve considering relationships between listed ideas, each idea would be related to every other idea in an attempt to forge or highlight a relationship. From such a starting point attempts would be made to start a chain of free associations which might lead to new products or ideas.

W.J. Gordon (1961) in his work entitled "Synectics" describes his own approach to this area of training as:

"An operational theory for the conscious use of the pre-conscious psychological mechanisms present in man's creative ability." P.3.

Gordon holds that:

"Creative efficiency in people can be markedly increased if they understand the psychological processes by which they operate... that in the creative process... the irrational is more important than the rational... (and that) ... it is these irrational elements which must be understood in order to increase the probability of success in a problem-solving situation."

Like others in this particular field of training for creativity, he is concerned to employ "play... to evoke new viewpoints with respect to problems"... "to make the strange familiar... and the familiar strange." In brief, he attempts to help individuals retain what he terms - "their peripheral vision", but he requires a high level of cognitive functioning.

Whiting, C.(1958) Creative Thinking. New York. cited in Osborn, A. (1963)
Gordon, W.J.J. (1961) Synectics: the Development of Creative Capacity.

Mednick with an associative concept of creativity has also shown interest in ways of inducing creativity. Creativity is here described as:

"... the forming of associative elements into new combinations which either meet specified requirements or are in some way useful. The more mutually remote are the elements of the new combination, the more creative the process or solution... however, it is only when conditions are such that this answer is useful and that we can also call it creative."

Training as such comes under categories such as:

Serendipity: the requisite associative elements may be evoked contiguously by the contiguous environmental appearance of stimuli which elicit these associative elements.

Associations under categories of Similarity and Mediation of Common Elements are also part of such training.

His tests are clearly based on the processes emphasised in the training undertaken and generally require subjects to relate in a remote way mutually distant realities.

In all training, it is not simply the structure of the situation which is of importance, but also factors such as time, length of training, amounts of training at any given time, and numerous other factors difficult to control, many of which must too often remain as 'hidden variables' in research designs. Parnes and Meadow (1959) hint at the problem of time in creative training schedules when they note in their own conclusions that:

"Those trained in brainstorming produced a significantly greater number of good quality ideas than those not trained... brainstorming is even more effective if preceded by extensive training."

Mednick, S. (1962) "The Associative basis of the creative process", Psychological Review, 69, No 3, pp 220-32.

Parnes, S. and Meadow, A. "Effects of brainstorming instructions on creative problem solving by trained and untrained subjects", J. of Ed. Psy., 50, No 4, (1959)

Edward de Bono employing terms such as "lateral thinking" believes that:

"... Creativity ought to be treated as a skill which can be taught, learned, practised and developed." (1970a) P.25.

De Bono, in an analysis of thinking, pinpoints the dilemma between the effectiveness of the human mind, which stems from its ability to create rigid patterns and to use them, and the consequent inability of the mind to escape from such patterns into new creations (1970a). De Bono's concern is to make individuals aware of their own thinking. He argues that such awareness of the processes of thinking can enable one to appreciate patterns, deviations and new processes. De Bono has further (1970b) analysed thinking into major types and his CoRT Thinking Programmes (1973) are attempts to put much of this analysis into practice. These programmes attempt to teach the various categories of thinking as a skill.

A problem with Programmes such as CoRT is that of de Bono's intention which is to make those taking part conscious of thinking as a process. Here the presentation of materials for such training is important. It is arguable that to benefit from this type of programme subjects require an understanding of the underpinning principles of thought if they are to avoid becoming engrossed in the details of presentation. "All leaves are orange" could be a generally agreed assumption for a logical discussion; however, to be freed from the absurdity of such a statement, some knowledge of logical argument might be essential. This problem would seem to be particularly acute when children are the subjects. It is not perceived as a problem in work aimed at older subjects, when one might assume a certain consciousness of thinking processes and of principles.

de Bono, E. (1970a) The Thinking Class. P.25

de Bono, E. (1970b) The Five Day Course in Thinking.

de Bono, E. (1973) CoRT Thinking Programmes.

Crutchfield (1966 and 1969) has, at different times, attempted to train in this area (PLATE 55). His concern has been largely with what one might term fluency as opposed to acceleration:

"... regardless of whether or not specific training can significantly speed up the time at which the various cognitive capacities emerge, it seems clear to us that the ability to use these capacities efficiently and effectively at any given stage of development can benefit substantially from direct training." (1969) P.68.

Overemphasis, in current education, on the known, with little attempt to enable students to cope with the unknown, is a concern of these authors. Both studies involving Crutchfield used the Productive Thinking Programme (1969, with modifications and additions). Again, the criticism might be - to what extent is the student able to disentangle the purposes and principles underpinning the programme from the comic-strip like presentation of much of it (see PLATE 55). It is believed that a certain grasp of such aims and principles is essential.

James Adams (1974) like previous researchers, shows concern to make individuals conscious of their thinking. He maintains that:

"The process of consciously identifying conceptual blocks, takes one quite a distance towards overpowering them." P.75

Like de Bono, Adams considers different types of thinking, and further, he examines different types of "blocks" to creative output, mainly perceptual, cultural and emotional; however, unlike de Bono, he would seem to regard the 'perceiver' as the one who must identify his own "Blocks" - in other words, such identifications and training require a certain level of cognitive maturity.

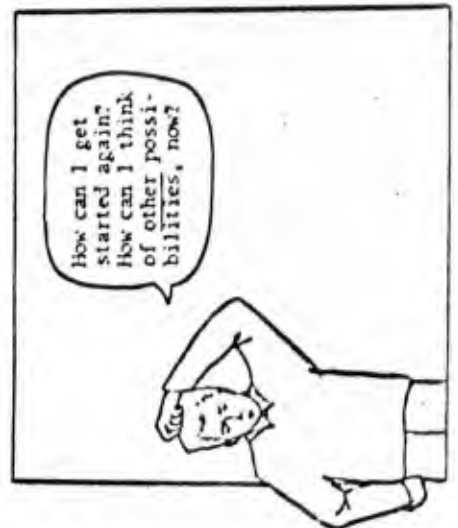
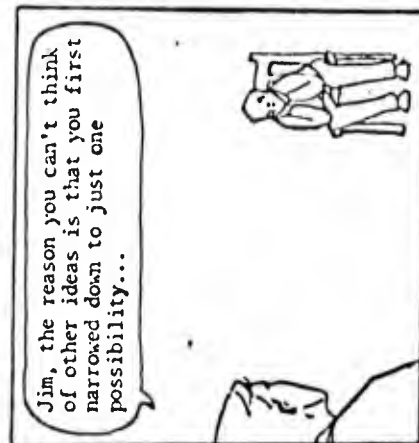
Crutchfield, R. and Covington, M. et al (1966) The Productive Thinking Programme. Berkeley.

Crutchfield, R. and Olton, R. (1969) "Developing the skill of productive thinking" in: Trends and Issues in Developmental Psychology, Mussen, P. and Langer, J. et al, Berkeley. P.68.

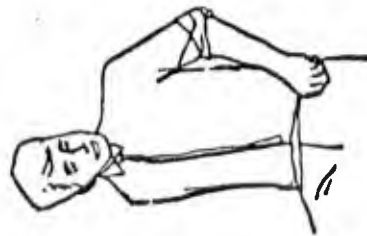
Adams, J. (1974) Conceptual Blockbusting. P.75.

Segment of a Lesson
from *The Productive Thinking Program*
(Copyright 1966 by Martin V. Covington,
Richard S. Crutchfield, and Lillian B. Davies)

Uncle John notices Jim's silence:



Here's another thinking guide that will give you a method for discovering many of the different ideas about this problem.



Pick out each of the important things in the story--each object and person. Then take each of these things one at a time, and try to figure out how it might have had something to do with the disappearance of the water.

This method will make sure that you don't miss any important part of the problem that could give you ideas.



Now, what will happen as Jim and Lila take Uncle John's advice? Turn the page to find out.

If creativity is about novel ways of apprehending and interpreting realities any training programme must take note of the subject's ability to comprehend the realities under consideration. Apart from such necessary cognitive maturity a training programme must provide opportunities for a subject to view realities from different standpoints. Put very simply, and with reference to the training undertaken here, a subject needs to realise, at his own level, that a square can be re-organised to make a number of triangles, that these same triangles can contribute to a larger triangle and so on. An important element here can be that of perceptual shift and re-interpretation (PLATE 56). Koffka (1936) discussing problem-solving says on this:

"... at first the problem cannot be solved, later on it can. The transformation which takes place in such cases implies as a rule that trace systems at first out of communication with the present processes are brought into communication with it."
(P.615)

Koffka goes on to illustrate by means of a joke, how an individual can fail to make use of information even when confronted by it. Until he apprehends it differently - until the appropriate trace system is contacted - he cannot re-interpret, and only the most superficial response is possible. The joke well illustrates both aspects:

"A asks B: 'What did Noah say when he heard the rain patter on the roof?'

B does not know the answer so A has to tell him, 'Ark!'

A little later B puts the same question to C who also has to be supplied with the answer.

B explains: 'Listen'." (P.615)

In some of the pre-pilot work for the training schedule, this same problem was encountered - and of course it is found in final results.

Items from Witkin's Embedded Figures Test showing varying degrees of "embeddedness".

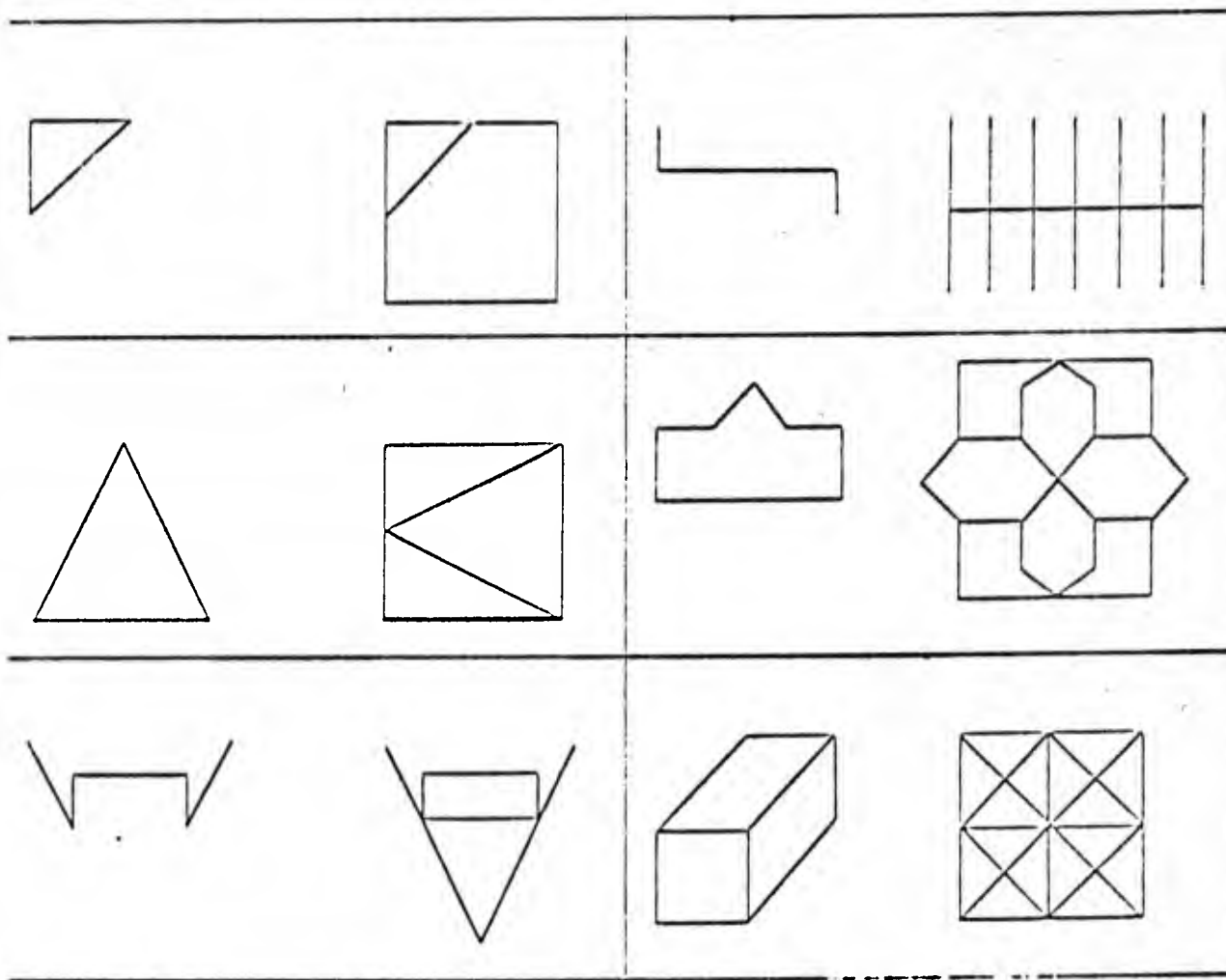


PLATE 56

Koffka points out that not all 'total situations' interfere with or obliterate the shape of a special part. Gestalt Psychologists have attempted to explain the factors governing such organisations. In re-structuring or 'creativity-type' tasks, a subject needs to be able to focus and re-focus upon the problem. An aim of creativity training could be to enable subjects to perceive and to re-interpret differently.

One subject (see Appendix II) did not at first realise that the block of flats could be conceived of as units. He was given this information (verbally and figurally), and to some limited extent he was able to act upon it, but not fully. It would seem that when an individual arrives at such re-definitions himself, there accompanies such re-definitions a grasp of the structural implications and possibilities. The question remains how does this come about and how open is it to experimental manipulation. Koffka continuing with this line of thought, talks of the notion of "embeddedness" and explains that:

"A trace strongly embedded in a trace system is less available for a new process than a trace loosely embedded." (1936)

How to 'loosen' a trace is of importance to creativity training. The concept of "embeddedness" is well illustrated in Witkin's Test, and it is clear that the surrounding context - in this instance, visual - plays a role in the visibility of the trace. It is believed that if a subject adequately understood the structure of a reality he would be less persuaded by context and more capable of an objective structural examination of the phenomenon under consideration. It is true that perceptual shifts can be chance events, but an understanding of the shift requires some understanding of the structure of a newly interpreted structure. New relationships develop from new emphases and interpretations. In the first part of this research it became evident that subjects able to perceive stimuli from numerous viewpoints were able to produce more varied and more numerous combinations. This is not to say that they were more or less creative as such, but that their field for the creative process would be wider.

From this review, it can be seen that creativity training has focussed on different aspects of the creative process. Some schedules have paid little attention to the subject's cognitive ability (or 'intelligence'), others have concerned themselves with perceptual shifts, and yet others with non-evaluative environments. Only a comprehensive approach, which attempts to pay attention to these several dimensions can hope to offer a comprehensive solution. The first section of this research attempted to offer a more comprehensive explanation of creative ability. On the basis of that definition and in the hope of understanding it yet more fully a training schedule is undertaken.

Chapter 9

EXPERIMENT AND PROCEDURE (2)

In the following section the rationale and aims of this second part of the research are set out. This is followed by a description of the sample and of general preparation.

There then follows a description and explanation of the tasks after which pilot work and the method of constructing assessment categories is presented. It is felt that pilot work, and consequent adjustments due to such, will be better understood if the finished tasks are presented first.

INTRODUCTION AND RATIONALE

A major assumption of researchers such as Osborn (1953) is that a lack of fluency in creative output stems mainly from variables which are more nearly personality type variables than from variables of a cognitive type. Whilst the current intention is not to underplay the importance of such personality dimensions, it is argued that cognitive variables are of prime importance. Unless an individual has understanding of the problem in hand, the use of non-evaluative techniques, etc. cannot bring about such understanding, though they may encourage a flow of responses of sorts.

Comments such as these force a return to starting concepts of creativity. Creative ability is here understood to be about transformations of reality, but a distinction is made between the kinds of transformations which show little or no understanding of the phenomena involved, and those transformations which stem from an adequate grasp of the initial items or events. True transformations require understanding. Fluency therefore can only be regarded as genuine fluency if the subjects understand the objects or events to be transformed and more, their own transformations of the objects or events. Fluency training, which is usually about attempting to increase easy expression and output, cannot therefore be separated from training schedules which attempt to increase understanding. Ultimately, training cannot be separated from the cognitive capabilities of the individuals involved.

Fluency training must therefore involve the following:

1. the establishment of the operational level of the subject(s) concerned;

Osborn, A.F. (1953) Applied Imagination: Principles and Procedures of Creative Thinking.

2. the subject(s) need to become familiar with the subject or area under consideration according to their level of operational ability;
3. the construction and presentation of tasks must relate to the operational level of the subject(s). Subjects characterised by concrete operational thinking, for instance, are not likely to be able to imagine (accurately and with implication) the consequences of factors X and Y being removed from a given situation.

SPECIFIC AIM

With these considerations in mind and in the light of findings in the first part of this research, an attempt was made to consider the effects of training in relation to the operational ability of the subjects involved, and to look at this in terms of understanding and fluency.

The training programme is divided into three parts:

- a) a set of tasks which serve as a pre-test establishing the level of ability of the subjects;
- b) a training session involving a set of tasks based on the structures and principles employed in the pre-test and eventual post-test, the aim of which is to familiarise the subjects with the structures in question;
- c) a post-test, based on the structures employed in the pre-test and the actual training session.

THE SAMPLE

100 subjects were involved in the pre-test in the second part of this research. They were drawn from three London Primary schools with similar catchment areas. Most of the subjects fall into Social Classes 3 and 4 (Registrar General's Classification).

No subjects involved in Part 1 of the research were involved at Part 2. The main reason being that a number of the children were now very friendly towards the Examiner, and it was felt that this might affect their attitudes towards the tasks. Also, there was some task similarity between Parts 1 and 2 of the research. The subjects were selected according to the method employed in part one of the research (see Chapter 4 for rationale). Teachers were asked to rate the children, in the age groups concerned, on the same 5 point scale as follows:

below average just average average good average above average

Each subject had to be selected as "good average" by at least two of the three teachers known to the child. Lists for the ratings were again compiled from the school registers. The first 40 children rated as "good average" from Primary School 1 were selected, and the first 30 from each of the other two Primary Schools were next selected. The percentages of subjects selected across the three schools were arbitrary and administratively convenient.

As the second part of the research included no verbal items, no reading scores were taken into account as in Part 1. In all the 100 subjects were grouped as follows:

- 25 girls in the 7-8 year old group
- 25 boys in the 7-8 year old group
- 25 girls in the 9-10 year old group
- 25 boys in the 9-10 year old group

This age range was selected because findings in Part 1 of the research suggested that these subjects were likely to have difficulties in transforming structures and objects and the aim of the training was to examine further these difficulties and to attempt to induce improvement.

All the subjects so far described took part in the pre-test. There were adjustments to the sample for the training session in the light of the performance of these subjects on the pre-test, for clearly the pre-test acted as a kind of selector for the training, and subjects "passing" the pre-test were dropped from the sample. Selection for the training was as follows:

- a) in the case of the youngest group (7-8 year olds) the first forty subjects (20 boys and 20 girls) were selected. As all of this age group failed to carry out the pre-test tasks concerned with re-structuring (with one exception), this was a straightforward procedure.
- b) in the case of the older age group (9-10 year olds) the first subjects to fail the re-structuring tasks were selected, but because of a slightly higher pass rate on the pre-test re-structuring tasks in this group, 3 extra girls and 2 extra boys were added to the initial sample. They were simply selected by the teachers, according to the usual selection procedure (i.e. rated on a five point scale, then pre-tested). In fact, only 3 extra girls had to be selected, but 3 boys had to be selected as one of the additional subjects also passed the pre-test. It should be pointed out that when results are reported in tables and profiles, the subject's original sample numbers are used. In the older group (9-10 years) the numbers are not in sequence because some, as explained, were dropped from the sample. Further, subjects added to the sample are denoted by * in all such tables.

PREPARATION AND PROCEDURE

After children had been selected, an explanation of the research was given to staff. The children were told that I was interested in puzzles - and wanted to find out more about them. They were asked, in their class

groups, if they would like to help me. Staff then selected as if for the first time, children who had been formerly selected. No child in the sample refused to come or showed any reluctance to do so. They were assured that the work was not a test, that it had nothing to do with school and would not be discussed with their teachers.

In two schools, the school library room was used, in the third school a small interview room was used. Including pre-assessment, training and post-assessment, the time spent on each subject was, on average, one hour.

THE TASKS (part 2)

Two structures only were selected for this training aspect:

a square and a triangle

In keeping with the rationale, the intention was to allow each subject the maximum opportunity to explore both of these structures, to change their shapes, to anticipate their changes, in other words, to encourage them to 'know' operationally. On the basis of a firm understanding, it is believed that fluency with a given structure will become a possibility.

Pask (1976) argues on the basis of his own previous research that:

"Concepts that are understood... (i.e. for which the learner has given an explanation and a derivation) are, in fact, stable."

Pask also argues that a conversational system of instruction is important in contributing to this stability for it forces the learner to make explicit their learning strategy (ibid). Though Pask's work had not

been encountered at this stage, the same considerations were in mind both in the construction of the tasks and the method of administering them.

In general, there were two types of task, distinct but related:

- a) tasks where subjects were required to interpret and re-interpret a given structure in several ways;
- b) tasks where subjects were required to re-interpret a given structure, and on the basis of such interpretations to form a new structure from the component parts of the initial structure.

There was no strict time limit for any part of the schedule, though generally, on average, each subject took about one hour to carry out all three parts of the training session.

There is standardisation of tasks and of task questions. Likewise the training session itself was standardised in terms of the tasks presented and the aid given, though, in addition, the strategies and questions of each child were followed up.

The subjects were allowed two trials on most tasks, more on some particular tasks, though the first trial was usually the only trial scored. Further trials were encouraged to allow a greater chance of exploration of the structures under consideration.

THE TASKS AND UNDERPINNING PRINCIPLES

In the first part of this research, eight main principles were proposed and assumed to underpin all creative transformations of reality. The tasks in this second part are based on those same principles as follows:

<u>Pre-Test</u>	<u>Principle(s)</u>	<u>Task Sheet</u>
Task 1	Apprehension and re-definition	(PLATE 57)
Task 2	Addition to an identity	(PLATE 58)
Task 3	Apprehension and re-structuring	(PLATE 59)
Task 4	Apprehension and re-structuring	

Training Tasks

Tasks 1 and 2 As for tasks 3 and 4 above.

Post-Test Tasks

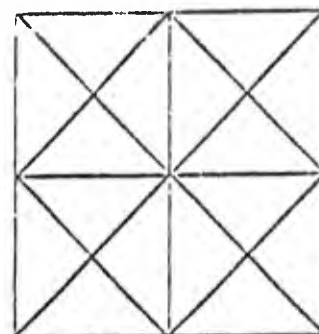
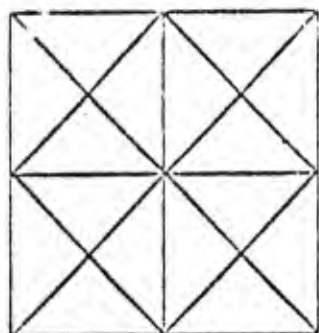
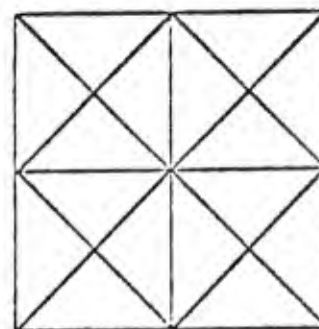
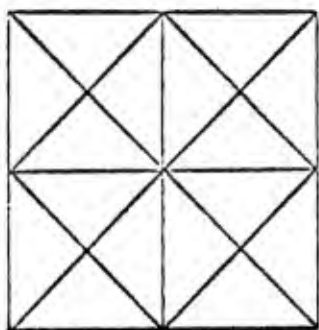
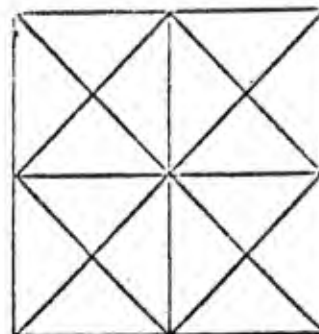
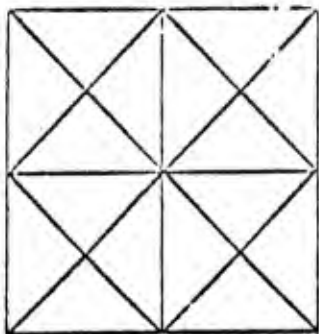
Task 1	Apprehension and re-definition	(PLATE 60)
Task 2	Addition to an identity	(PLATE 61)
Task 3	Apprehension and re-structuring	(PLATE 62)
Task 4	Apprehension and re-structuring	(PLATE 63)

PRE-TEST TASKS

Task 1: Shape Recognition (task sheet overleaf)

This task was concerned with apprehension and re-apprehension. Solutions could come about by means of perceptual shifts and emphases, or through the ability of subjects to consider each component part of the structure in relation to the next.

All subjects were aided on the first item to introduce them to the logic of the task. The first diamond shape (the required response) was shaded in, with or for them. It was also established that they understood what was intended by a diamond and a triangle shape. Before the second item (b) in this task the following Practice Task was given:

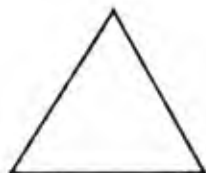
PRE-TEST. Item 1.PLATE 57

shade this in so that you have:

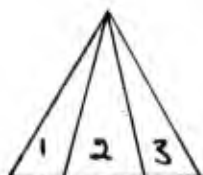
- a. 2 diamond shapes.
- b. a triangle with 2 triangles inside.
- c. a triangle with a diamond shape inside.
- d. a triangle with 4 triangles inside.
- e. a square with 8 triangles inside.

Ss. were given the possibility of two trials for each task. There were 10 presentations of the above figure on the test sheet.

"Now this is a triangle"



"This is a triangle with three triangles inside of it"



"Which are the three?
Show me."

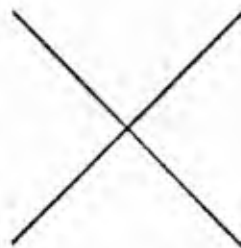
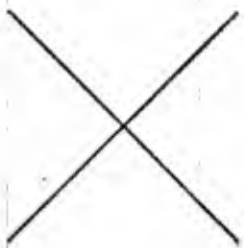
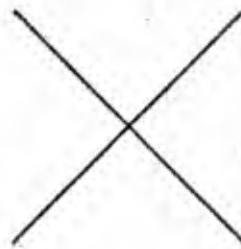
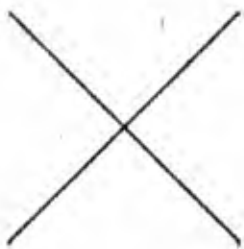
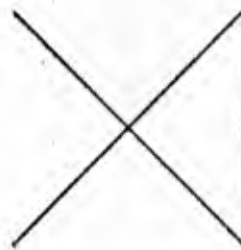
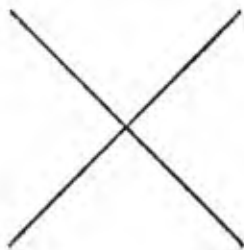
"Now, looking at these shapes (page 366) I want you to find a triangle with only two triangles inside of it."

The task was a pencil and paper task.

Task 2: Elaboration (see over for test sheet)

This task is concerned to examine the subjects ability to anticipate change in an identity and to extend identities. It relates to Piagetian investigations into concepts such as 'hindsight' and 'foresight' (Inhelder and Piaget, 1964, P.196). Such concepts require a certain level of operational stability, the need to be able to understand the essentials of a structure and to retain a fairly stable concept of that structure both in terms of what it is and of what it could become.

Inhelder, B. and Piaget, J. (1964) The Early Growth of Logic in the Child.

PRE-TEST. Item 2.PLATE 58

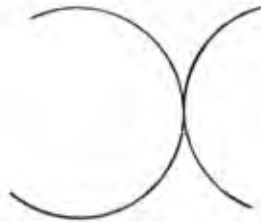
add to this so that you have:

- a. 2 squares.
- b. 6 triangles - all the same.
- c. 8 squares.

Ss. were allowed the possibility of two trials for each task.

Subjects were given two trials for each task and a certain amount of concrete experimentation was possible. To introduce them to the task the following trial item was used:

"If I gave you the following lines - what would you have to add to them to turn them into two circles?"



Subjects were given help if needed.

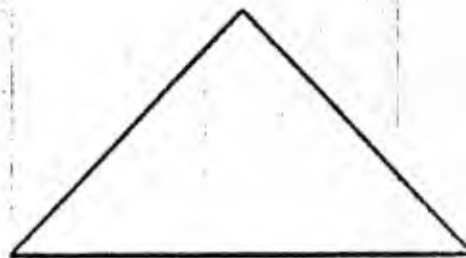
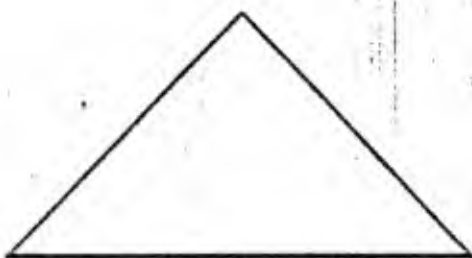
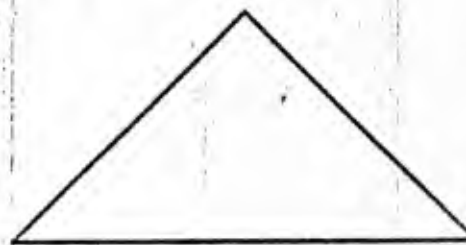
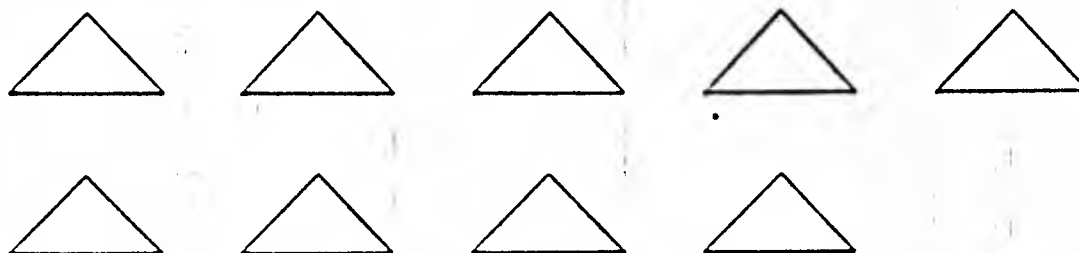
"Fine, now I'm going to show you more lines."

The Examiner then continued according to Plate 58. (see previous page).

Task 3:

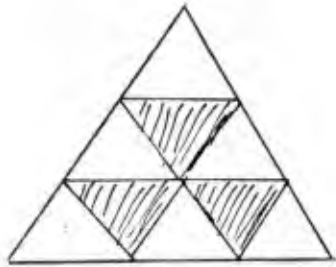
This is a pre- and post-test task. Essentially the task is concerned with apprehension and with re-structuring on the basis of what is apprehended. Unless the subject is capable of perceiving the structure in terms of the related units comprising it, he will not be able to re-structure. Similarly, if the subject fails to make figure-ground discriminations, difficulty will be experienced in fitting in the parts as follows:

(see page 371 for illustration).

PRE-TEST. Item 3.PLATE 59

How could you fit all of the small triangles into one of the large triangles. Draw them in to show how they would look.

Ss. were given the possibility of 6 trials for this task.



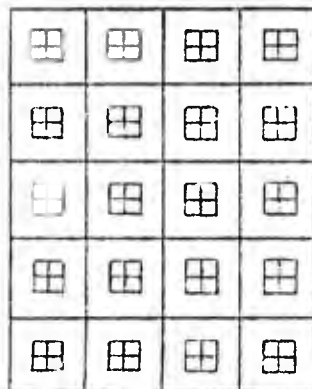
There is a tendency for certain triangles to become 'figure'. However, the task is possible only if 'ground' triangles are counted. A sound grasp of identity and structure could enable subjects to overcome such perceptual persuasions.

The explanation of the task was varied slightly according to the age group:

e.g. 7 year old subjects: "Now this is rather like a jigsaw puzzle.

Here you have nine small triangles. All of these small triangles fit into one of these triangles (points) - they will go in if you put them in the right way. I'd like you to draw on this big triangle here, showing how the small triangles will look when they are all fitted in ... yes the nine small ones all fitted into this one here."

Item 4:



This is a pre- and post-test item concerned with apprehension of the units comprising the structure - and with re-structuring. Subjects

were presented with a sheet on which there was a diagram identical to the above and space for drawing. It was explained as follows:

"Now, on this sheet there is a picture of a block of flats. I'm going to ask you if you will change the SHAPE of this block of flats in some way.

Now there is one main (big) rule - you can only use the blocks and the windows shown on the picture. You have to use all of these pieces and you cannot add anything - you cannot add doors or windows - just use what you see here but in a different way. "

Questions of clarification were allowed.

THE TRAINING TASKS

The Triangle Task

It is perhaps important to state that the training experience is "concrete" in that the subjects are given flat card pieces (jig-saw style) of the structures to be handled.

There is no set time limit and the aim is to work with each child until such point as the individual is able to master the tasks with the aids provided.

When it is clear that the child cannot carry out the tasks, prompts are given and the child is required to repeat the task until he can do it alone. The child is asked to explain what he is doing and why.

The tasks have their own sub-logic - for example:

In Task 1, the child is required to make 4 triangles out of 8 pieces.

He is then required to make two triangles out of these four.

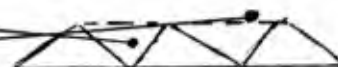
The subject may of course not realise this sub-logic.

An example of the type of prompt given may help:

In item 3 of this first training item, in constructing the large triangle from all of the pieces - after the child has explored without success - the following base is provided:

Then: "What goes in here? How?"

Then: "What goes on here? How?"

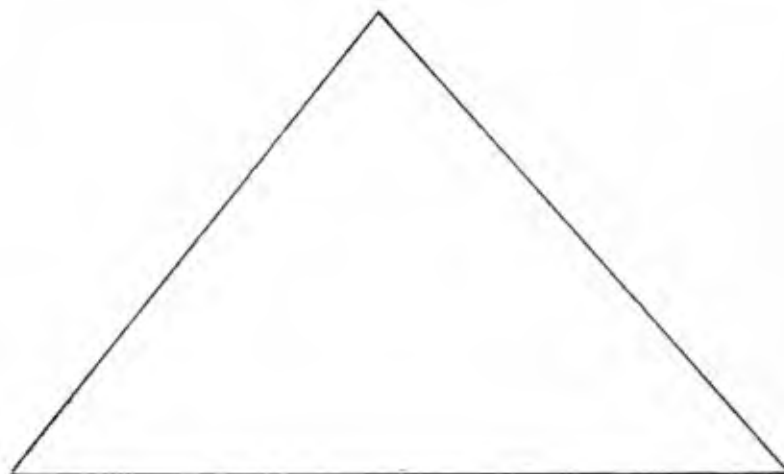


This is repeated as needed.

Task 1:

Materials - 9 equilateral (or right/left angled) triangles, made in thick card.

Actual size -



Aim - that by carrying out given tasks, subjects might become more aware of the different ways of structuring these same pieces.

Items:

1. Make four triangles, each one the same (material = 8 pieces).
2. Make two triangles, each one the same (materials = 8 pieces).
- * 3. Make one big traingle using all the pieces (materials = 9 pieces).
(Subject is reminded of pre-task 3 where he had to draw this.)
4. Make two squares - each one the same (materials = 8 pieces).
5. Make them into one big square using all the pieces (materials = 8 pieces).
6. Make one big traingle using all the pieces (materials = 9 pieces).

Time:

No set time limit. Varied according to the understanding of each child.

* repeated until grasped by the child.

Task 2: House Task

For this task, the subject was presented with 20 flat cards, each about 1" x 1", (jigsaw style). The cards, when assembled, represented the building (flat) used in the pre-test task. The subjects were asked to notethis fact.

The Examiner began by putting the pieces together to make the flat - 5 blocks high, 4 blocks across. The Examiner then questioned the child as follows:

Item (a)

"Now you take these pieces and make this block of flats into two blocks. Make each block look different in some way."

Item (b)

"Now (having returned to the original construction of a block of flats) could you change the shape of this building in some way... look, you could do this for a start... (an example given)"

Item (c)

"Could you build a building with these pieces so that there are four blocks on the ground floor, and two on the very top floor. You can do whatever you like in between."

Item (d)

"Could you build the building so that there is an archway through the building and so that the top floor has six blocks across."

Item (e)

"What else could you do with them?"

Further explorations were encouraged.

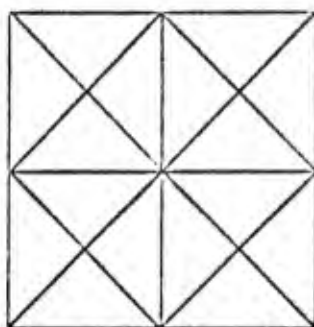
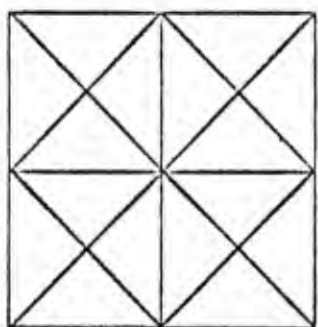
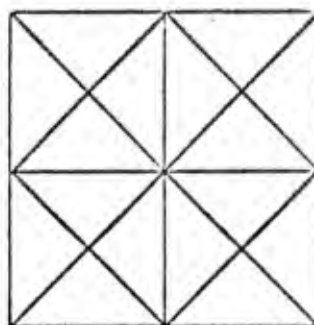
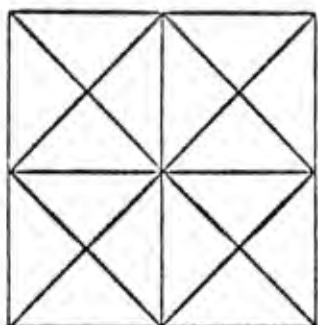
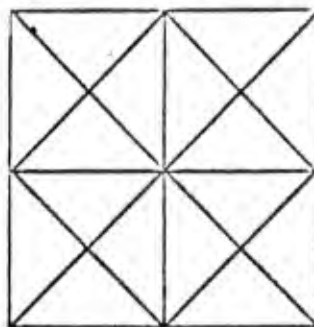
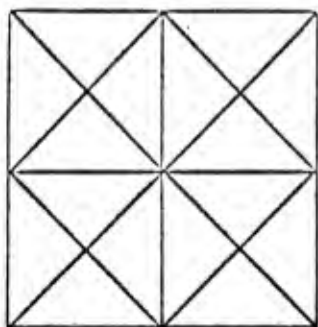
POST TEST TASKS

Tasks 1 and 2 (see overleaf) were essentially the same as the pre-test tasks. They were included in this post-test:

- a) to provide some 'interference' between the training experience and assessment of that experience. The intention was to try to reduce or avoid rote memorisation of structures.
- b) to provide further experience with the two main structures under investigation.

Responses were not scored.

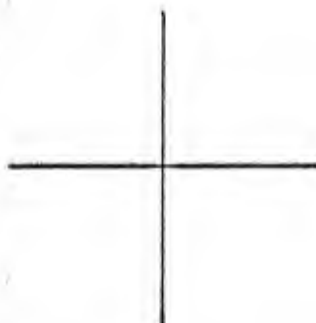
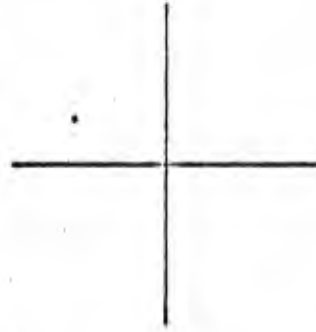
Tasks 3 and 4 (see over) were the same tasks as employed in both the pre-test and the training session, based on the triangle and house structures. The intention was to see if the limited amount of training could enable the subjects either to improve on these tasks or to succeed. Before each of these tasks, subjects were reminded of their training session with the jig-saw-like pieces.



shade this in so that you have:

- a. a shape like a house.
- b. a shape like two houses.
- c. another shape like two houses.

Ss. were given the possibility of two trials for each task.



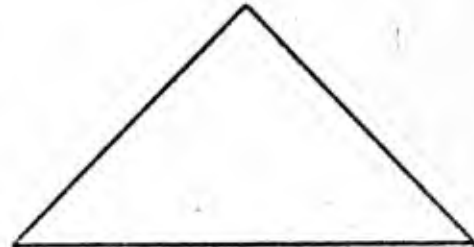
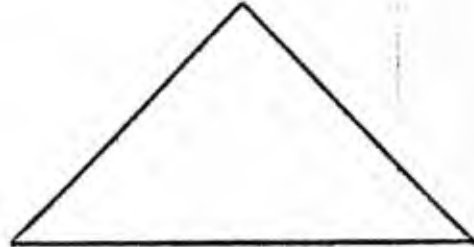
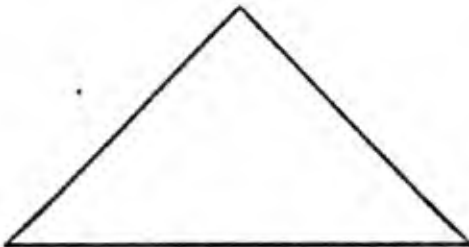
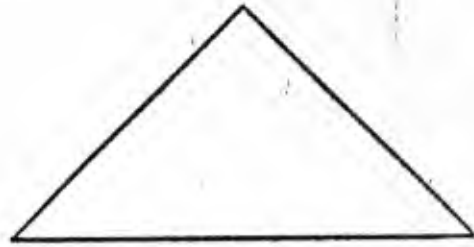
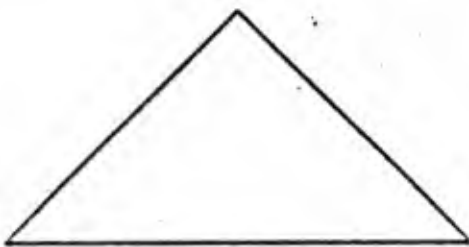
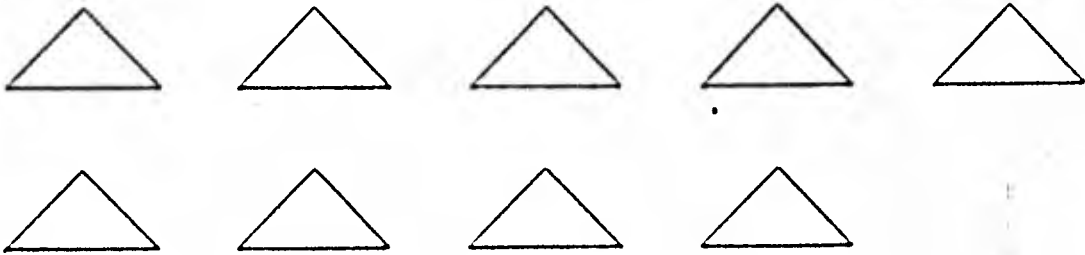
add to this so that you have:

- a. 2 squares and 2 triangles.
- b. 8 triangles.
- c. 1 square, with 4 triangles inside of it.

Ss. were given two trials for each task.

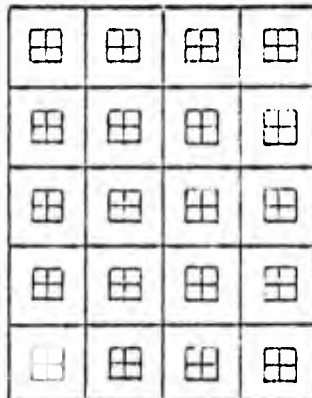
Pretest and Post-test Task as required. (Item 3 in POST TEST).

PLATE 61



How could you fit all of the small triangles into one of the large triangles. Draw them in to show how they would look.

As in the pre-test Ss. were given the possibility of 6 trials for this task.

POST TEST. Item 4.PLATE 62

Now here is a drawing of a block of flats. I would like you to change the shape of this block of flats in some way.

You have to use everything shown on the picture here - you can't miss anything out, and you can't add anything either.

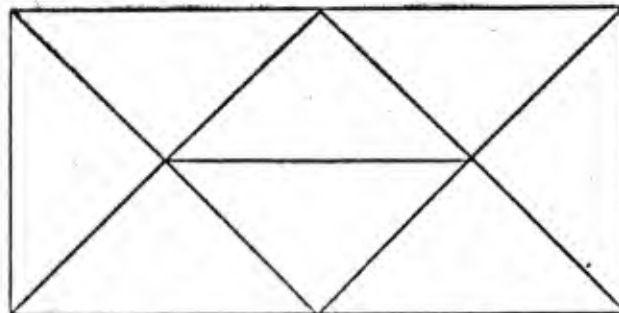
Just change the shape using everything in the picture.

Task 5

This is a transfer task. The intention was to distinguish between improvement (which might be exhibited on Tasks 3 and 4 above) based on noting of facts and memorisation, and improvement based upon a grasp of the essential principles underlying the tasks.

The transfer task is a re-structuring problem.

See PLATE 63 over page.

POST TEST. Task 5. (transfer)PLATE 63

The above diagram (actual size) was presented to the child with the following instructions:

This is a drawing of the top of a table. I would like you to change the SHAPE of this table top in some way - it can be any shape you like but you can only use the pieces shown on the diagram here. You can't add anything to the drawing and you can't take anything away.

How many pieces are there on here?

This latter question was put, and explanations were given until the child replied "eight pieces"

PRE-PILOT AND PILOT WORK (2)

Pre-Pilot Work (see Appendix II for details of these pre-pilot sessions)

As in Part 1 of the research, the main aim of the pre-pilot work was to enable the researcher to better formulate problems for further investigation. Six subjects were involved in this pre-pilot work: 3 in the 7-8 age range and 3 in the 9-10 age range. There were three boys and three girls - the children came from the same primary schools as those involved in the second part of the research, but they did not take part in pilot work or in the main assessment. They were selected on teacher ratings, as previously used here. The main intention was to attempt to understand the kinds of problems, and the reasons behind the problems, that the younger child has in understanding and transforming identities. The house task, used in Part 1 of the research was used in the pilot work. Working with the house task in its initial form, led to a change of technique in presentation as a result of the problems encountered, and to the use of jig-saw-like pieces, as already described in the explanation of the tasks for Part 2. The pilot work revealed that the most fundamental problem was that of the child's initial perception of a structure and his inability to re-apprehend it in different terms. Further, when another interpretation was pointed out, the child was able to note this re-interpretation but he was not able to act upon it.

Pilot Work

Six subjects took part in the pilot work - the group being of the same composition as that for pre-pilot work and selected in the same manner. These subjects simply worked through the items used in the second part of the research. The purpose of the pilot work was to enable the researcher to construct categories for the assessment of the tasks, to

come to terms with the conversational method employed, and to seek for any inconsistencies or problems prior to commencing the main work. The pilot findings were not included in the final results.

CATEGORIES FOR ASSESSMENT (Part 2)

As with Part 1 of the research, the categories resulted from observation of the responses of subjects in both pre-pilot and pilot work and in the light of responses in the first part of the research. The focus in this second part was less on a search for detailed explanatory categories but rather on success and failure and the reasons for such.

Task 1: Shape Recognition (pre- and post- Tasks)

There were 5 items in the pre-test presentation of this task. Help was given with the first item, leaving four to be tackled by the subject. A subject was allowed to fail one item only. A subject who passed 3/4 was regarded as having passed that item.

In the post-test presentation of this task, there were three items and the subject was required to satisfy at least two of these in order to pass the task. Two trials were allowed for each item but after permitted experimentation, only the first formal attempt was scored.

Task 2: Elaboration

In both the pre- and post-test presentations of this task, there were three items and the subject was required to satisfy at least 2/3 to pass the task. Again, two trials were allowed and a certain amount of experimentation was allowed, but only the first formal attempt was scored. As already explained, the purpose of the second attempt was to enable the subject to become more familiar with the structure, with guidance if necessary.

Task 3: Re-structuring (1)

In both the pre- and post-test presentations, six trials were allowed for this task because of its assumed difficulty and because it was to be one of the central tasks on the training programme. Again, a certain amount of experimentation was allowed but only the first or second formal effort was scored. Subsequent trials were used for experience. In actual fact, no subjects in the younger group scored on this task and only a limited few in the older group did so.

Task 4: Re-structuring (2)

In both the pre- and post-test presentations of this task, each subject was allowed to experiment in advance. Only the first or second formal presentation was scored. Subsequent attempts were solely to aid experience and understanding. Again, successes were few.

Task 5: Transfer

This task was scored on a pass/fail basis.

SCORING

As the categories employed here were quite definite and less open to the kind of subjectivity that could affect scoring, no panel of raters was employed.

Chapter 10

A CONSIDERATION OF THE FINDINGS

In this section there is a description of the findings, including illustrations, in relation to the theory underpinning the research.

This is followed by statistical analysis of the findings, and further interpretation in the light of this analysis.

A question arising out of Part 1 and out of the pilot studies for Part 2 was that of facing individuals with facts - would such encounters bring them to a grasp of structural implications? It seems rather that when an individual arrives at definitions and re-definitions himself there accompanies such definitions, a grasp of their structural implications and possibilities.

The first two tasks of Part 2 of the research were concerned to discover more about ways in which children, at different levels of operational ability, apprehend and define structures. Both tasks are essentially convergent in nature in that subjects have to respond according to predetermined outcomes. In the first part of this study there were two similar tasks - both concerned with apprehension and with elaboration of structures - but both were divergent in that subjects could respond as they wished: the outcome was not defined for them. Amongst the observations noted then, it was seen that it was only by the age of 9 or 10 years that half of the subjects were able to identify a shape then draw, as opposed to drawing then naming after the event. This divergent task gave a further freedom to the subjects in that they were free to identify structures which they recognised and, as noted, the younger subjects tended to identify more obvious structures and less complex ones, especially in terms of the amount of stimulus lines used. The intention in Part 2 was to look at what might be termed 'deliberate or conscious' re-structuring as opposed to chance 'recognitions' and chance re-structurings. For this purpose, subjects were presented with simple structures (squares and triangles) and asked to group and re-group them to produce different forms. In other words, to apprehend them differently for each of the task items.

SCORES ON PRE-TEST ITEMS

(Numbers of subjects passing in initial sample of 100 subjects
for Part 2)

Item 1 Recognition	Item 2 Elaboration	Item 3 Re-structuring 1	Item 4 Re-structuring 2
<u>7-8 years</u>	<u>7-8 years</u>	<u>7-8 years</u>	<u>7-8 years</u>
5/25 (girls)	5 (girls)	0 (girls)	1 (girls)
4/25 (boys)	5 (boys)	0 (boys)	0 (boys)
<u>9-10 years</u>	<u>9-10 years</u>	<u>9-10 years</u>	<u>9-10 years</u>
21/25 (girls)	11 (girls)	8 (girls)	8 (girls)
20/25 (boys)	12 (boys)	7 (boys)	6 (boys)
<u>Totals</u>			
50	33	15	15

Totals are on a possible 100.

Figures do not include extra subjects in 9-10 year age band for the training programme.

Subjects succeeding on items 3 and/or 4 were not included in the training programme which was based upon these items.

SHAPE RECOGNITION TASK 1

This task is essentially concerned with apprehension and re-apprehension - the realisation that forms and events can be constructed and re-constructed to produce different outcomes.

There was a practice task and a further explanatory task to ensure that the child could grasp the intention of the questions. Of the younger age group (7-8 years) only nine on a possible 50 subjects (i.e. pre-test sample size) accomplished this task successfully as opposed to 41 out of the possible 50 in the 9-10 age group.

This younger age group appeared to have great difficulty in following the stimulus lines and would make comments such as:

"I saw it - now it's gone" and

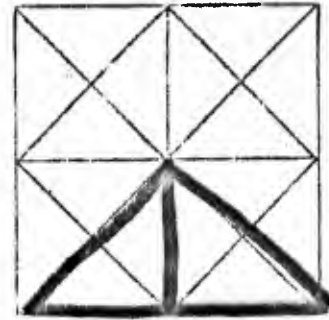
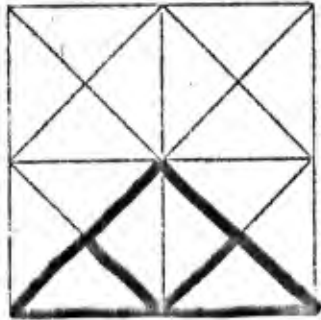
"Oh, it's a lot of diamonds.... I thought it was..."

In general, they seemed very vulnerable to perceptual shifts and impressions, with little control over their perceptual insights, unlike the older group who attempted to 'follow through the lines' and who illustrated some ability to search and to assess the parts, both independently and in relation.

Apart from this problem, the younger age group failed generally to focus upon the double aspects of the questions:

e.g. "I would like you to find a triangle with two triangles inside of it. Only two remember."

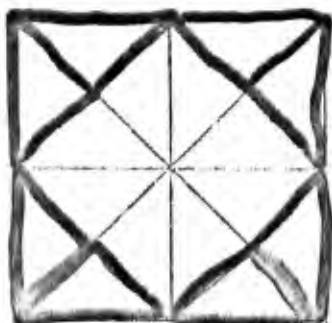
In general, the younger age group either selected two triangles (not inside of a triangle), a triangle and another two triangles, or found a triangle with more than one triangle in. As illustrated on the following page, attainment of one solution seemed to prevent them from proceeding to another - especially when structures were similar.



- a) "a triangle with a diamond inside of it and two triangles. b) a triangle with two triangles inside of it.

Having arrived at solution (a) or having been presented with this solution, subjects in the 7-8 years age group were generally unable to re-construct it. They were unable to understand that the same form could be reconstructed by adding a line to form "a triangle with four triangles inside of it". Suggestions to this effect were generally countered by comments such as: "but I've just used that for this question". Sometimes they tried to avoid this problem of their own invention by moving to another section of the square - identical in structure - and working there.

The same difficulties were encountered in problem (b). Most younger subjects were uncertain that form (b) could become a "triangle with four triangles inside of it by the addition of two lines.



"A square with only 8 triangles inside of it." girl: 7-8 years.

When asked about the 'other triangles' the subject clearly failed to grasp the point of the question. The triangles were pointed out. The subject's reply was that they were not part of her picture.

Subjects in the younger age group (with the exception of 9/50) had great difficulty in re-defining the structure before them in this task. More importantly, they did not seem to realise that the same structure could be re-interpreted.

Older subjects who were generally more successful on the task (41/50) approached the problems knowing that there could be different constructions and seeking them. This was evidenced by the ways in which they turned the paper around, hid parts of the pattern with pieces of paper to arrive at another form, and mentally traced the lines extending them to other possibilities. It would seem that the youngest group was hindered by a profound difficulty: that of not fully grasping the fact that re-constructions were a possibility, whereas the older children had problems which stemmed more from lack of flexibility, set, etc.

The implications for any kind of creative behaviour are clear. A fundamental requirement is the realisation that a thing can become something else. This realisation implies a structural grasp of the event or object, and will affect the ways in which the problem is approached. A second requirement is that of availability/flexibility of ideas (a content versus a structural problem) with regard to what the thing could become. In terms of training for creativity, these are two distinct problems requiring and leading to different methods and outcomes respectively. A grasp of the first issue - the realisation that a thing could be 'other' involves an understanding of knowledge itself; the second is a matter of leading subjects to an awareness of the kinds of transformations possible. In the second case, an individual might be hindered by factors such as set, habits, illusions, etc. In the first instance, he is hindered by a lack of operational knowing.

Re-structurings leading to 'creative' outcomes require a further condition: the realisation that re-structurings could lead to a form not yet 'recognised' and 'known' as a distinct identity. Thus, the creative knower must approach issues aware of their structures, of the possible variations and of the 'yet to be recognised structures'. If an individual is incapable of realising that a structure can become another structure, if he is unable to recognise a named known structure embedded within a total structure, he is not likely to structure new events and objects which are equally embedded in what is known, which cannot be defined in advance, and which have yet to be recognised as identities per se. It would seem from observations here, that the concrete operational knower has enough cognitive organisation to know an identity, to reverse, and re-structure that identity in concrete forms. But he is tied to the concrete forms and to the definitions such forms impose upon the concrete knower (e.g. a triangle made up of 9 smaller triangles can be seen only as being composed of 9 smaller triangles. It is the formal operational knower who can more readily grasp that it could equally be made up of diamond shapes and of triangles or of smaller triangles, etc.) Piaget has shown frequently how the relational dimension of events and objects escape the concrete knower (e.g. Piaget, 1928). Until he can escape from this stage he cannot know the "what is" in terms of the "what could be". Indeed his grasp of the "what is" would seem to be inadequate for things and events can be more fully understood by contrast if they can be known over and against what they could have been or could become.

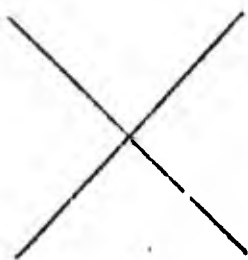
ELABORATION TASK

In Part 1 of this research project an Elaboration Task was included, but there, in keeping with the intentions subjects were encouraged to elaborate freely. However, it was noticed amongst the younger subjects that not only did the task provide problems, but also many younger subjects elaborated without knowing what their elaboration was to be. The matter of being able to anticipate a form is one of interest here. It is seen as an aspect of 'knowing' - of potential identity. Here therefore, subjects are required to elaborate in certain ways to see if they can make such anticipations.

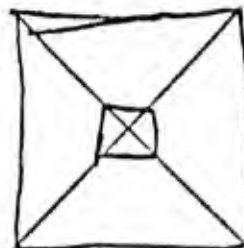
This proved to be a much more difficult task. Only 10/50 of the 7-8 year olds were able to 'pass' on the item and only 23/50 of the 9-10 year olds. In nature, this task is more abstract than the previous one as only part of the evidence is before the subjects. They are required to provide the remainder. Because they were allowed two attempts some chance of concrete exploration (diagrams) was possible but did not prove to be of any real help. Errors common to both age groups were:

- a) ignoring the partial structure provided and drawing what was required without this structure;
- b) an inability to resist closure and simply join lines - point to point, irrespective of the instructions;
- c) difficulty in actually copying a completed structure when provided.

Subjects in both age groups anticipated badly the effects of their own drawings. Strictly speaking, this task needs the abilities of the formal operational thinker for the elaborating requires that the subject go beyond the immediate information, and further, because the task is



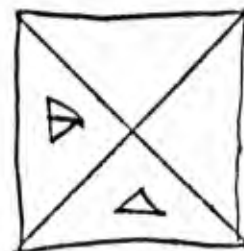
a. stimulus lines.



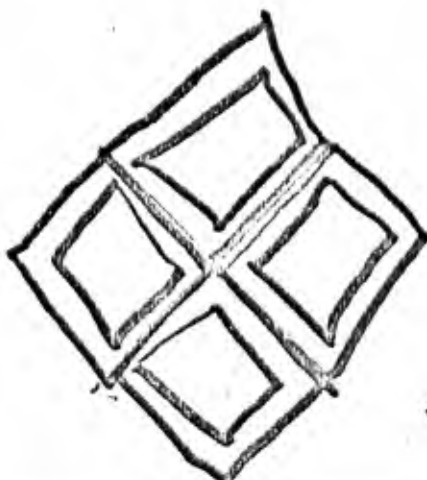
b. "two squares"



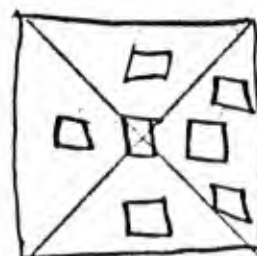
c. "six triangles"



c. "six triangles"



d. "eight squares"



d. "eight squares"

Boy: 7:5.

Girl: 7:6.

Responses typical of the majority of subjects
in this age band.

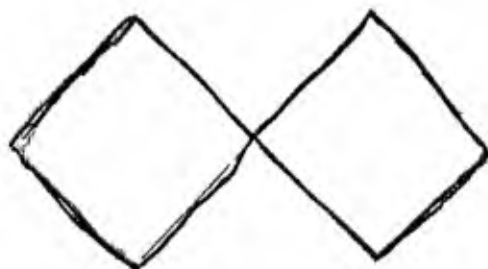
convergent, he must know his direction in advance. Free elaborations can allow a subject to extend freely and aimlessly, naming objects after the event (see first half of study).

Piaget (1956) is concerned largely with what Flavell (1975) terms "space representation" as opposed to "space perception". Dodwell (1968) commenting on the distinction in different terms writes:

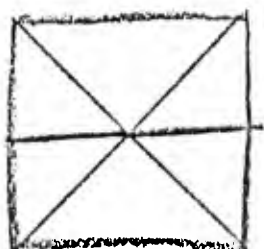
"Piaget makes a perfectly reasonable distinction between perceived space and conceived space: whereas a quite young child may be able to distinguish perceptually between, say, a square and a circle, this does not mean that the child can conceptualise this difference or marshall the operations which are necessary for making anything more than a perceptual distinction." (P.119)

This became obvious in the Elaboration Task here. All of the children in the sample were familiar with the square as a structure in that all could make perceptual distinctions. Many, however, had problems in developing a partial structure into a square, and could not anticipate the lines of direction, could not conceive of the completed square. Even in the 9-10 year old group only 23/50 were able to 'pass' this item. Until a child can conceive of a form he cannot re-conceive of it and he cannot therefore act upon it in a potentially creative manner.

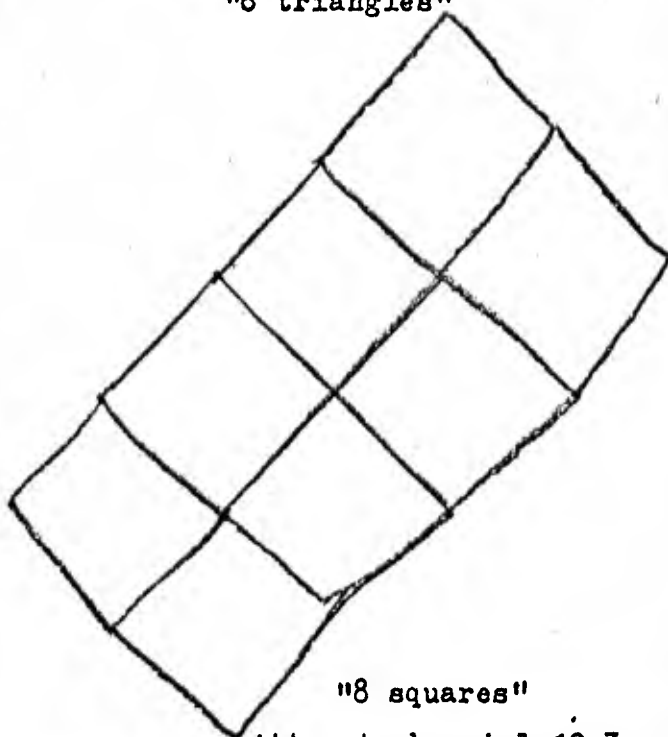
Piaget, J. and Inhelder, B. (1956) The Child's Conception of Space.
 Flavell, J. (1975) The Developmental Psychology of Jean Piaget.
 Dodwell, P.C. (1968) "Children's understanding of spatial concepts" in:
Logical Thinking in Children, Sigel and Hooper. P.119.



"2 squares"



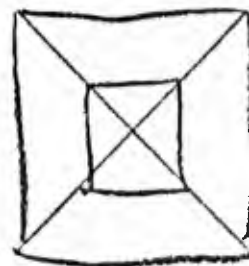
"6 triangles"



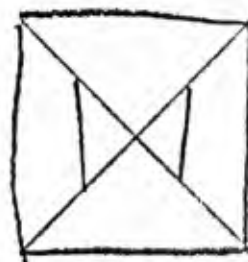
"8 squares"

Attempts by girl 10:3.

"2 squares"

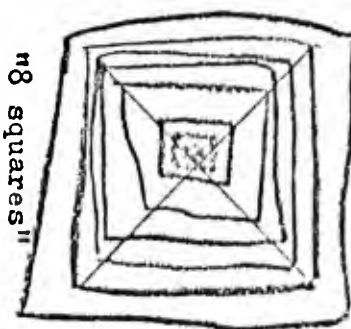


"6 triangles"



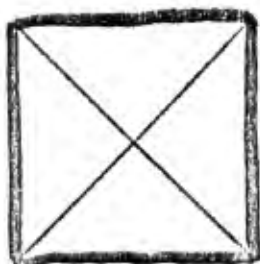
Attempts by a boy aged 10:4.

"8 squares"

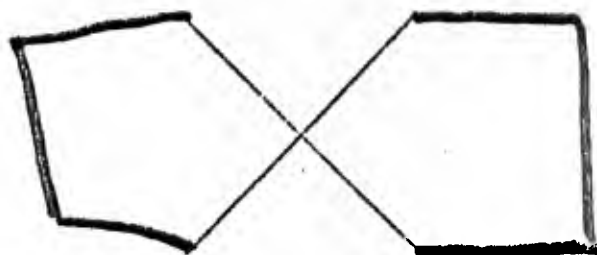
PLATE 65

Within the 9 - 10 years age band less than half of the subjects were able to carry out this task with any accuracy.

Attempts such as those illustrated on the right hand side of the page were still frequent within this age group.



a.



b.

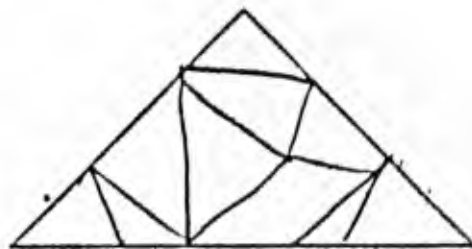
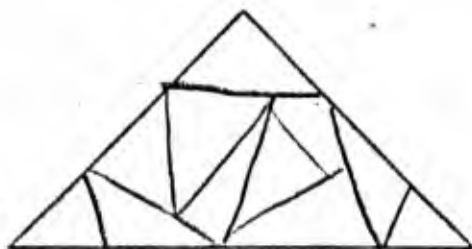
a. In spite of the initial example worked with all Ss. response a. was the immediate and most general response for the 7 - 8 year old group, and given by about $1/3$ of the older age group. It was only on completing their response that such Ss. then wondered about the second square.

b. This example shows two attempts, typical of the 9 - 10 years group, to turn the initial structure into two squares. Ss. were aware that the structure would have to extend in some way, but found it hard to see how. When shown the correct solution, they still found it hard to anticipate the direction of the extended lines, and with the exception of $9/50$ of this older age group, the remainder had to arrive at the solution by means of drawing a line, crossing it out then trying again.

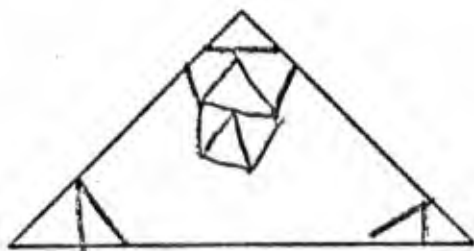
TRIANGLE TASK (Pre-test: Re-structuring 1)

This task was the first actual pre-test task on which, together with the subsequent task, subjects were selected for training. Only one of the 7-8 year olds carried out this task successfully and only 15/50 of the 9-10 year olds did so. However, there were subjects in both groups who had a better grasp of the solution than others and who were able to understand that the nine triangles making up the one large triangle, would have to inter-relate. In the 7-8 year old age group 15/50 did attempt to relate the component parts (8 girls, 7 boys) and in the older age group 17/50 (9 girls and 8 boys) related parts, in addition to the 15/50 who actually passed the task.

One problem for those unable to relate the component parts was an inability to realise that the outer framework (i.e. the large triangle) would in fact form parts of the smaller triangles placed on its bases. For many of the younger subjects this outer triangle was approached as a separate structure. Some of the problems of failing to relate component parts are illustrated in a selection of diagrams of attempts on the following page. In some instances, there was considerable distortion of the component parts in an attempt to relate them. There was also, amongst all subjects failing to relate, poor handling of space (large spaces left) and what might be termed "figure-ground" problems. As anticipated, some subjects often failed to see that by creating 5 triangles they were in fact creating 7 triangles - for they were only regarding the 5 as figure. They were confused when the 'extra triangles' were pointed out. The full implications of their own re-structurings were not always grasped. Those children who made no attempt to relate components parts sometimes announced that the problems were easy - and simply drew 9 triangles in the large triangle - each triangle independent of the others and of the general structure!



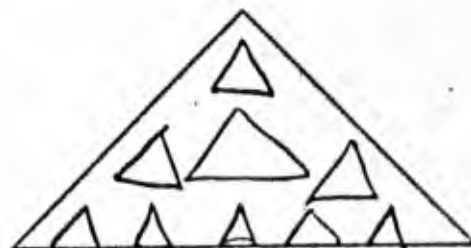
girl 8:1. 1st and 2nd attempts.



girl 7:5. 1st attempt.



girl 7:5. 2nd. attempt.



boy 7:10. 2nd attempt.

PLATE 66

Attempts by Ss. in the younger age band to show how the nine smaller triangles would fit into the large triangle.

No subject in this age band carried out the task correctly, though about a third of the age band made some attempt to relate the triangles to one another.

(e.g. see above girl:8:1)

PRE-TEST - THE HOUSE TASK

This task is identical to that used in Part 1 of the study and little need be said therefore with regard to the quality of responses. It was used largely to select subjects for the training sessions. Of the total sample for Part 2 in the 7-8 year old age group only 1/50 passed this task (a girl). In the older age group only 14/50 succeeded. There were, however, in addition to those who succeeded, subjects who managed to re-structure the problem, but on a non-unit basis - e.g. sometimes by turning the building longways, or by "cutting" a piece off and placing it elsewhere (5/50 such subjects - 3 girls and 2 boys). Both groups, but especially the younger subjects illustrated the errors found in Part 1 of this study.

PRE-TEST AND POST-TEST PERFORMANCE ON TRAINING ITEMS

Score in () indicates pre-test scores.

Score without () indicates post-test scores.

- = not applicable.

Task	Age	Fails	Partial Success	Success	Transfer Correct
Re-construction (1)	7-8 years	(40) 36	(11) 15	(0) 4	- 2
Re-construction (2)	7-8 years	(40) 32	(4) 1	(0) 8	- 2
Re-construction (1)	9-10 years	(40) 17	(21) 13	(0) 23	- 15
Re-construction (2)	9-10 years	(40) 12	(9) 4	(0) 28	- 15

- i) figures denote the number of subjects within any one category.
 - ii) all scores are on a possible total of 40 within each age-group.
- A profile of each subject's entire performance on all tasks will be found in Appendix IV.

TRAINING - TRIANGLE TASK

There were differences in operational ability between the two age groups who were to be trained. Of the younger age group only 11/40 attempted to relate the triangles. 21 subjects made no attempt to do so in the pre-test. Of the older - 9-10 years age group, 21/40 were relating the component parts in the pre-test. Obviously, none of the subjects for training had carried out the task wholly successfully. These differences of "degree of success" are important and are reflected in the final training outcomes. Some subjects 'improved' as a result of training - as will be seen - but 'improvement' did not necessarily mean attainment of the correct solution or the ability to generalise the ability learnt to other similar tasks.

From the actual training session - certain observations are of interest. Subjects were handed the 9 pieces (small triangles) composing the larger triangle which they scattered on the table. They were then asked to treat the pieces as a jig-saw and to make 4 triangles - using all 8 pieces. Only 6 subjects out of 80 (9-10 years group) counted and 'organised' the pieces. Generally, there was no attempt made to work out how many pieces would be required to make each triangle. The second task was based upon the first task. It required subjects to make 2 triangles using all the pieces (8 pieces). The same principle was required here as for task one - i.e. putting two triangles together. Generally, however, subjects began the second task with no 'mental model' of how to approach the problem.

The central task - "now make one big triangle using all 9 pieces" was approached in the same way. Generally, the following was noticed:

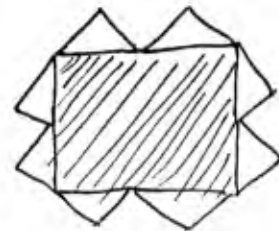
- a) no initial counting of the pieces;
- b) forgetting the shape towards which they were working;
- c) non-systematic examination of the parts, e.g. some subjects picked up other identical pieces of the structure in an attempt to find the solution. This latter behaviour was very typical of the younger age group.

Other behaviours indicated a lack of systematic knowing. For instance, with the exception of one subject in the younger age group, all of these subjects would manipulate both triangles when trying to relate them - not realising that one had to be held constant (Cf. Piaget, - and experimental investigation). About half of the older age range showed this lack of systematisation.

More than half of the younger subjects adopted a 'figural approach' to the triangle problem - outlining a triangle with the pieces - but not forming a triangle by inter-relating the component parts, e.g:



a) a 'figural attempt at a triangle'.



b) a 'figural' approach to a square.

After a subject had constructed the triangle from the nine pieces (with or without help) he was required to study it, was asked how many pieces were on the base ("bottom line") etc. Subjects were required to repeat tasks, and especially this triangle task - until they could do them with ease. Further tasks were given (see test outline) then

there was a return to the triangle task. Some of the younger subjects showed hesitation on a return to this task and approached it clearly trying to remember a structure but not always clear as to what it was.

In a number of instances (9/40) during the training, the younger subjects reverted to initial non-systematic approaches. In such cases, training was continued until such behaviour seemed to disappear.

The outcome of the training for this task depended upon the level of ability at the start of the task.

In the 7-8 year old group prior to training the following was so: 11/40 subjects related the component parts when drawing.

Of these 11 subjects who related, 4 carried out the triangle task successfully on the post-test.

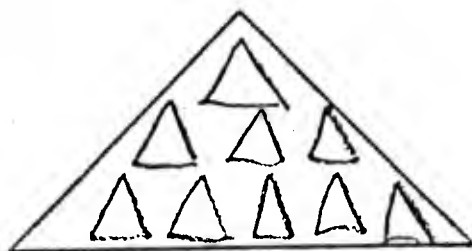
Of these 4, 2 showed an ability to apply the principles to the transfer task.

Of these subjects from this same age group not relating component parts on the initial assessment (i.e. 29/40 in all):

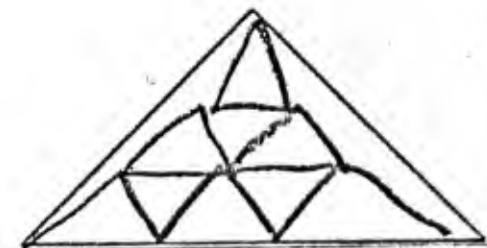
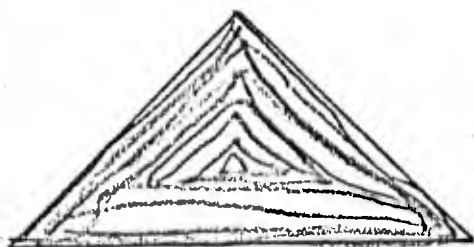
None passed the triangle task itself, but 6/29 of these subjects not initially relating did relate component parts on the post-test.

In both senses, therefore, i.e. in terms of either a move to relating or to carrying out the task 23/40 subjects showed no improvement after training of this type.

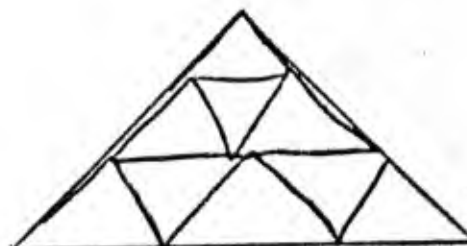
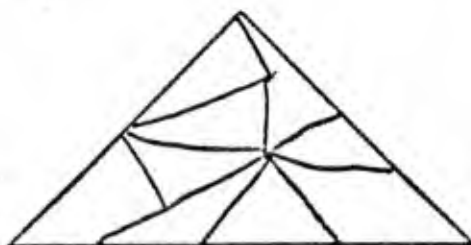
In the older age range, subjects seemed to be 'more able' to benefit from the actual training - in Piagetian terms, it may well be possible to argue that such older subjects were on the brink of such 'operational understanding' and that the experience tipped them in the right direction. In like terms, it could be argued that the younger subjects lacked the structures capable of assimilating the principles involved in the tasks.



Boy: aged 7:8.



Girl: aged 7:9.



Boy: aged 8:1.

PLATE 67

Figures on the left of the page illustrate attempts by 3 different subjects to carry out the triangle task. Figures on the right of the page illustrate attempts by the same subjects after the training session.

The 'improvement' of each subject varies according to the initial grasp of the task.

Of the older age group, on the pre-test:

21/40 subjects related the component parts of the triangle (including correct responses).

Of these 21 subjects who related the parts, 17 succeeded on the triangle task in the post-test and 14 of these 21 showed an ability to generalise the principle to a transfer task

Of these subjects from the same age group not relating component parts on the initial pre-assessment (i.e. 19 in all):

9 of these 19 did relate units on the post-test;

6 actually passed the triangle test itself;

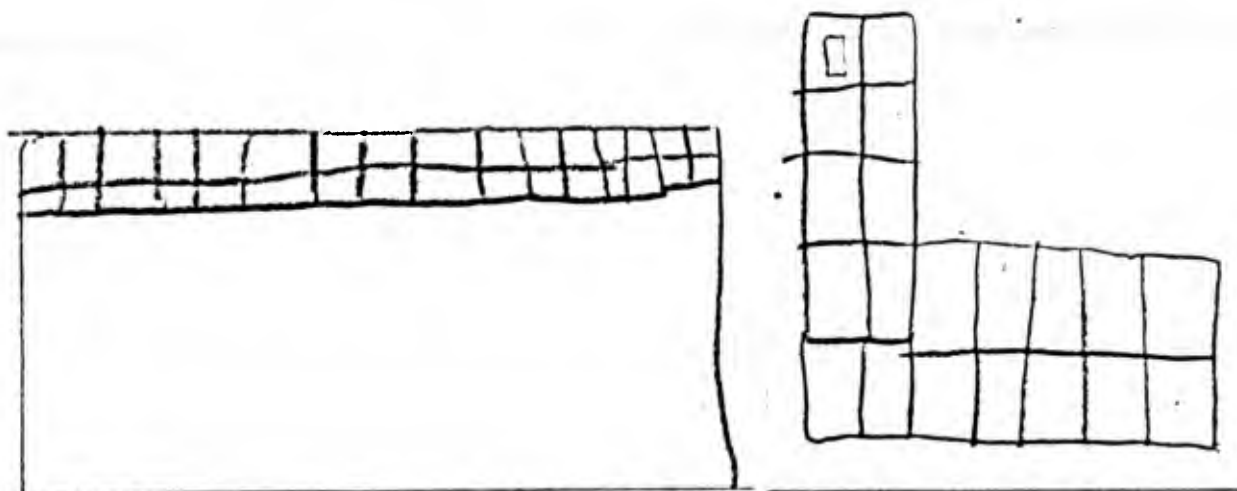
and 4 failed to do either after the training experience.

More subjects in this older age group were able to profit from the training than in the younger age group.

THE FLAT TASK

(Again subjects were given jig-saw like pieces with which to work.)

Very similar behaviour was illustrated here, both in terms of the training observations themselves and the actual outcome of the training, though generally, in the actual training session the subjects found the tasks to be much easier - they were in fact provided with the units (blocks with windows) and had what was essentially an open-ended task to perform, i.e. there was to be a change of shape - but that shape change could take any form. No demands were made on the subjects in terms of relating or inter-relating the parts as in the previous training task. In concrete form, therefore, the task proved to be very possible for all subjects in both age ranges.



Attempts by a girl aged 8:1 before and after training.

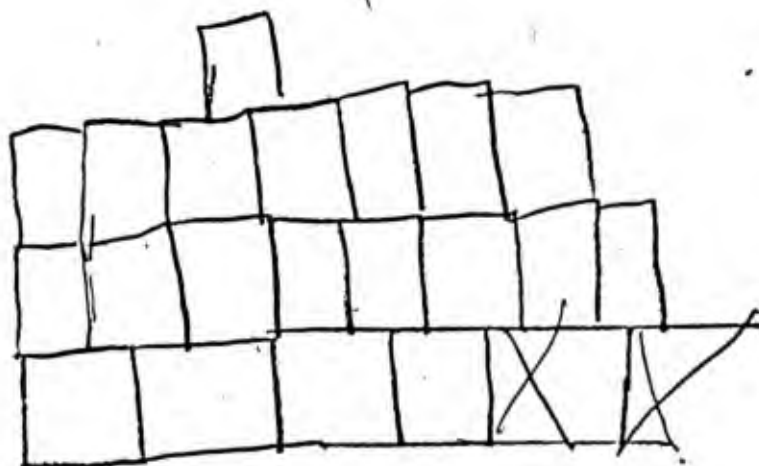
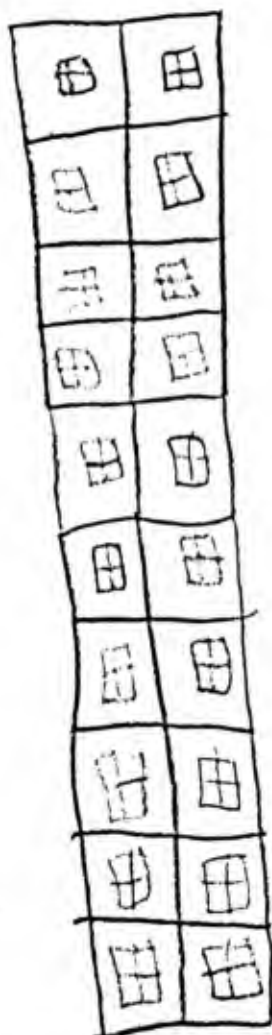


PLATE 68

Attempts by a boy aged 7:5. before and after training.

This subject had some difficulty in anticipating the final form of his second attempt (see crossed out sections)

Of the 7-8 year old group, in the pre-assessment, only 4/40 subjects could carry out the re-structuring but on a non-unit basis. Of these four subjects, 3 carried out the post-test task successfully. Of the other 36/40 subjects in the same group: 5 carried out the house task successfully on the post-test. Few subjects in this age range seemed able to benefit from the training offered here. Interestingly, at the concrete level these same subjects during the training session, when definitions of the structure were provided (i.e. jig-saw pieces), were able to offer a variety of new shapes for the flat.

Of the older age group, in the pre-assessment: 9/40 of the subjects carried out this re-structuring task but on a non-unit basis. All of these 9 subjects carried out the task successfully on a unit basis in the post-test. Of the other 31 subjects in the post-assessment: 19 carried out the task successfully; 12 failed to carry out the task and in this sense showed no improvement at all due to training of this type.

Again, it could be argued from this that until such time as subjects have adequate cognitive structures to assimilate the training and its implications for further tasks, such training fails to make lasting changes on such strategies.

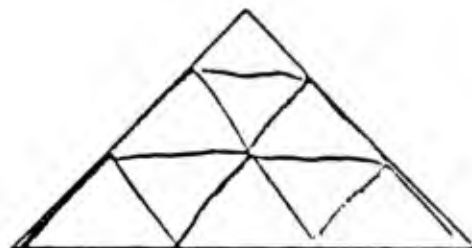
TRANSFER TASK

Within the 7-8 year old group, whilst eight subjects succeeded on Re-construction (2) and four subjects succeeded on Re-construction (1), only two managed the Transfer Task. Similarly, within the older age group (9-10 years), 23 subjects passed Re-construction 1 and 28 passed Re-construction (2) but only 15 succeeded on the Transfer Task. This is consistent with the main underpinning theory in that it is argued that some 'success' on post-training tasks was based on memorisation but not upon understanding of the principles. Thus it was not possible to apply understanding to similar problems.

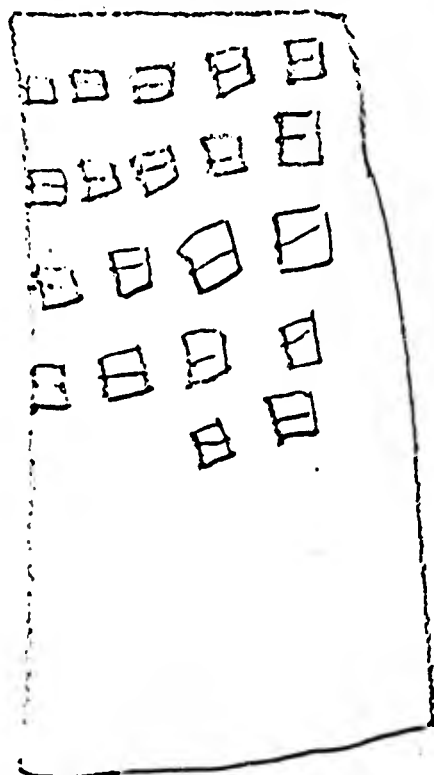
The attempts of a subject (aged 9:6) who could not carry out the transfer task.



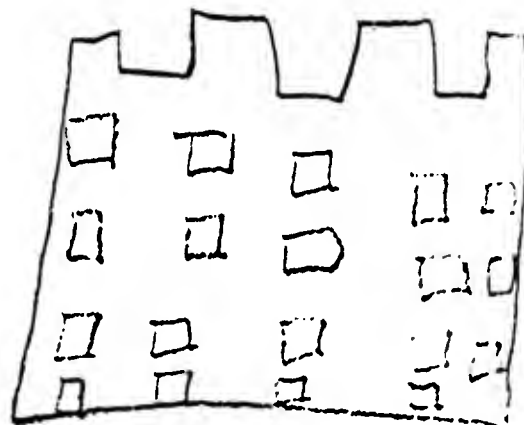
a. pre-training attempt.



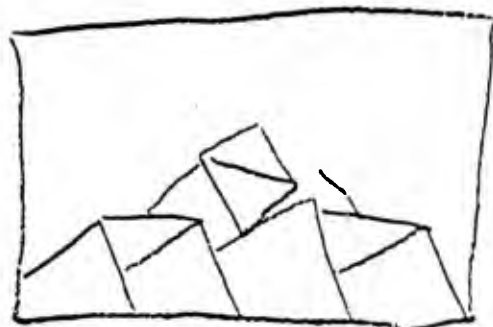
b. post training attempt.



c. pre-training attempt.



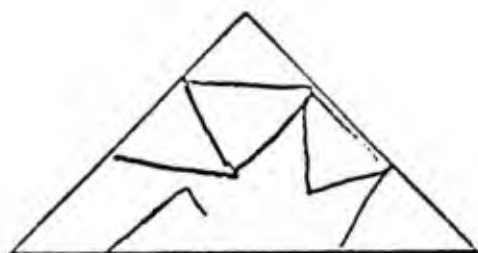
d. post training attempt.



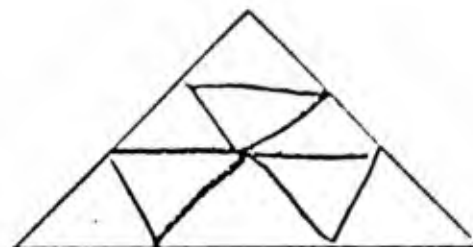
e. transfer task attempt.

The attempts of a subject (aged 10:2) who was able to carry out the transfer task.

PLATE 70



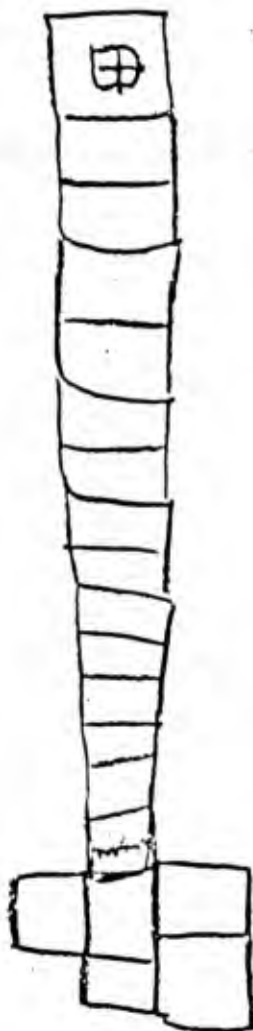
a. pre-training attempt



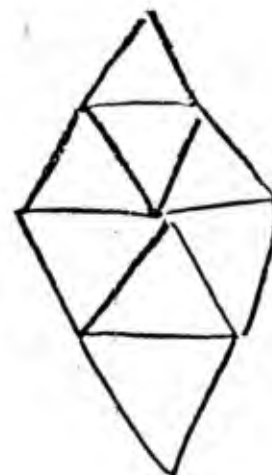
b. post-training attempt.



c. pre-training attempt.

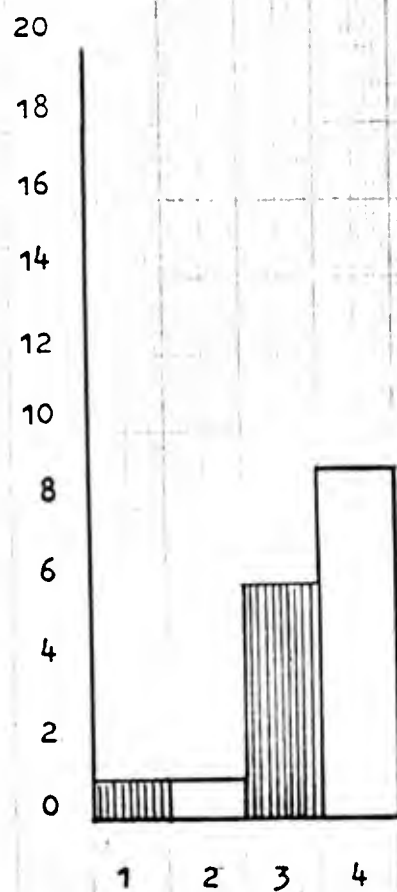


d. post-training .



e. transfer task attempt.

No. of Ss. passing transfer task by age & sex.



1 = 7-8 yr. old boys.

2 = 7-8 yr. old girls.

3 = 9-10 yr. old boys.

4 = 9-10 yr. old girls.

IMPLICATIONS FOR FURTHER TRAINING ATTEMPTS

Depending upon one's concept of the learner, so the 'blame' for apparent 'failure' in any training attempt can be placed either within the learner himself (i.e. immaturity of structures, etc), or within the training schedule.

Piaget, as cited earlier, is firmly convinced that development and not learning is the way of understanding. Learning is seen as limited in that it is tied to a single structure and transitivity is not possible. However, whilst accepting Piaget's main tenets on this issue, it is believed that there is a place for some training - depending upon the aims of that training. The training carried out here is related to a study of structures required for creative behaviour, and in particular to an ability which is seen as fundamental to all knowing - creative and logical - that of apprehending and of defining reality.

Training schemes for creativity must first establish that individuals apprehend and define reality in ways common to their culture. They must be enabled to know those realities operationally - first at a concrete level of knowing until abstraction becomes a possibility. But given operational ability - fluency training becomes a possibility. Once individuals can know the structure of a given reality, once they can re-shape that reality, reverse it, re-structure it, they can begin to know that it can be re-structured. The possibility of reflection upon one's own cognitive behaviour makes creative transformations of reality possible. Piaget speaks of the importance of understanding action and of knowing oneself in that action. He is speaking here not so much of self-knowledge, but of the realisation that reality comes to us patterned; that we are the patterners and that as such, once we know the patterns and ourselves as patterners - we can change the design.

To conclude this section on training, it is important to stress that Piaget's theoretical model is perhaps, in the area of training in particular, best approached as some ideal type. Formal operational knowing is a cognitive ideal - not a guaranteed outcome in every area. Piaget himself has room for *décalage* and for concrete operational adults. Creativity training might need to involve one with familiarisation in an area. An individual might well have to proceed through concrete experimentations to a stage when conceptual knowing takes on. The adult learner driver provides a case in point. Whilst he may not wish his earliest gropings around the gear box to be described in sensori-motor terms he will be far from having a clear, stable, concept of the gear box - except perhaps as a learnt fact, and not as knowledge transforming his actions and acting.

Statistical Analysis and the Findings (Part 2)

There are several factors which the researcher wished to examine in the second part of this research. The tasks used here are based upon the same principles as outlined in the first part of the research (Elaboration, Re-construction, etc). Therefore, this second part provides a further opportunity of examining the inter-relationships of tasks, though this was not a prime aim.

The main intention of this training investigation was to note:

- a) any improvement in performance with experience, and
- b) evidence of ability to transfer to other tasks what is assumed to have been gained during the training sessions.

The statistical tests chosen for this second part of the analysis are those tests used in Part 1 of the research. Namely, Analysis of Variance and Chi-Squared Tests. Though the composition of the sample was different in this second part (i.e. two age groups of 40 subjects with an equal number of boys and girls in each, as opposed to eight age groups of 12 subjects each with an equal number of boys and girls in each group), the methods of selection and of scoring were the same, and the assumptions underlying the Tests of Analysis of Variance and Chi-Squared Tests (already explained in Part 1) were believed to be satisfied.

Again, as for Part 1 of the research, and for the reasons given then, all tests were one-tailed tests. The tables are presented on the following pages.

Explanations of Tables

Set 1 - Standard F Tests (Analysis of Variance) (sex and age)

These are for the Standard ANOVA tests, for identifying variation between factors, in this case, sex and the two age groups. The ANOVA table shows which factors are significant, i.e. have variation which is significantly larger than would be expected from random effects.

Finally, Chi-Squared tests were applied, ignoring sex differences, assuming there was no difference between the age groups. It was found that for all but C and F, there is an age variation.

Set 2 - Relationships between Pre-test Items

These are the contingency tables for testing whether each pair of tests in A-D are in fact independent. Since significant results were obtained for age-groups in the F-tests, this analysis was split into age groups. The figures in green are the observed frequencies, those in red are the expected frequencies calculated by
$$\frac{(\text{Row total} \times \text{Column total})}{\text{Grand total}}$$

Set 3 - Relationships between Post-test Items

These show first the tabulated scores for each pass/fail combination for both age groups (sex ignored). Secondly, the contingency tables for each age group are given. Again, green-observed frequency, black-observed corrected by Yate's Correction, red the expected frequency.

Set 4 - Relationships between Transfer Task and Others

As for Set 3. There are tables for each combination of the Transfer Task with all others.

Set 5 - Improvement in Performance

The tabulated successes for each pass/fail combination are shown first.

PART 2 TABLES

Set 1 - Standard F Tests

(Analysis of Variance)

(age and sex)

Including Goodness-of-fit Testsfor age effects.

TEST: SHAPE RECOGNITION

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	5	16	21
BOYS	4	13	17
TOTAL	9	29	38

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.2	1	0.2	1.05
AGE	5	1	5	26.31 *
SEX x AGE	0.06	1	0.06	0.26.
RESIDUAL	14.7	76	0.19.	
TOTAL	19.95	79		

* Significant at 5 % level.

TEST: ELABORATION

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	5	7	12
BOYS	5	8	13
TOTAL	10	15	25

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.0125	1	0.0125	0.056
AGE	0.3125	1	0.3125	1.409
SEX x AGE	0.0125	1	0.0125	0.056
RESIDUAL	16.85	76	0.2217	
TOTAL	17.1875	79		

* Significant at % level.

TEST: RELATES COMPONENT PARTS (1)

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	6	12	18
BOYS	5	9	14
TOTAL	11	21	32

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.2	1	0.2	0.859
AGE	1.25	1	1.25	5.367 *
SEX x AGE	0.05	1	0.05	0.215
RESIDUAL	17.7	76	0.233	
TOTAL	19.2	79.		

* Significant at 5 % level.

TEST: RELATES COMPONENT PARTS (2)

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	1	5	6
BOYS	3	4	7
TOTAL	4	9	13

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.0125	1	0.0125	0.0909
AGE	0.3125	1	0.3125	2.273
SEX x AGE	0.1125	1	0.1125	0.818
RESIDUAL	10.45	76	0.1375.	
TOTAL	10.8875	79		

* Significant at % level.

TEST: RESTRUCTURING (1) CORRECT [POST-TEST].

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	1	14	15
BOYS	3	9	12
TOTAL	4	23	27

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.1125	1	0.1125	0.67.
AGE	4.5125	1	4.5125	26.895 *
SEX x AGE	0.6125	1	0.6125	3.65
RESIDUAL	12.75125	76	0.1678	
TOTAL	17.8875	79		

* Significant at 1 % level.

TEST: RESTRICTING (1) PARTIALLY CORRECT. [Post-Test].

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	9	5	14
BOYS	6	8	14
TOTAL	15	13	28

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0	1	0	0
AGE	0.05	1	0.05	0.215
SEX x AGE	0.45	1	0.45	1.93
RESIDUAL	17.7	76	0.23	
TOTAL	18.2	79		

* Significant at % level.

TEST: RESTRICTING (2) CORRECT [POST-TEST].

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	4	16	20
BOYS	4	12	16
TOTAL	8	28	36

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.2	1	0.2	1.056
AGE	5.0	1	5.0	26.39 *
SEX x AGE	0.2	1	0.2	1.056
RESIDUAL	14.4	76	.1895	
TOTAL	19.8	79		

* Significant at 1 % level.

TEST: RESTRACTIONS (2) PARTIALLY CORRECT [Post-test]

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	0	0	0
BOYS	1	4	5
TOTAL	1	4	5

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.3125	1	0.3125	5.723 *
AGE	0.1125	1	0.1125	2.06
SEX x AGE	0.1125	1	0.1125	2.06
RESIDUAL	4.15	76	0.055	
TOTAL	4.6875	79		

* Significant at 2.5% level.

TEST: TRANSFER TASK.

	7 - 8 yrs.	9 - 10 yrs.	Total.
GIRLS	1	9	10
BOYS	1	6	7
TOTAL	2	15	17

ANOVA:

	SS	DF	MS	F-RATIO
SEX	0.1125	1	0.1125	0.774
AGE	2.1125	1	2.1125	14.53 *
SEX x AGE	0.1125	1	0.1125	0.774
RESIDUAL	11.05	76	1.454	
TOTAL	13.3875	79		

* Significant at 1 % level.

GOODNESS OF FIT TESTS FOR AGE EFFECTS (Yates Correction applied)TEST.

		7 - 8 yrs.	9 - 10 yrs.	Total
<u>Shape Recognition.</u>	O_i	$9\frac{1}{2}$	$28\frac{1}{2}$	38
$\chi^2 = 9.01 *$	E_i	19	19	38

TEST.

<u>Elaboration.</u>	O_i	$10\frac{1}{2}$	$14\frac{1}{2}$	25
$\chi^2 = 0.64.$	E_i	$12\frac{1}{2}$	$12\frac{1}{2}$	25.

TEST

<u>Restructuring (1)</u> <u>Partially Correct.</u>	O_i	$11\frac{1}{2}$	$20\frac{1}{2}$	32
$\chi^2 = 2.828$	E_i	16	16	32

TEST

<u>Restructuring (2)</u> <u>Partially Correct</u>	O_i	$4\frac{1}{2}$	$8\frac{1}{2}$	13
$\chi^2 = 1.23.$	E_i	$6\frac{1}{2}$	$6\frac{1}{2}$	13

TEST

<u>Restructuring (1)</u> <u>Correct (Post Test)</u>	O_i	4	23	27
$\chi^2 = 13.42 *$	E_i	$13\frac{1}{2}$	$13\frac{1}{2}$	27

* Significant at 5% level.

Post-test cont.

<u>TEST.</u>		7 - 8 yrs.	9 - 10 yrs.	Total.
Restructuring (1) Partially Correct	O_i	15	13	28
	E_i	14	14	28

$$\chi^2 = 0.143$$

<u>TEST.</u>		7 - 8 yrs.	9 - 10 yrs.	Total.
Restructuring (2) Correct.	O_i	8	28	36
	E_i	18	18	36

$$\chi^2 = 11.111 *$$

TEST.

Restructuring (2)
Partially Correct

Not suitable for this analysis due
to very low response rate.

* Significant at 5% level.

<u>TEST</u>		7 - 8 yrs.	9 - 10 yrs.	Total.
Transfer Task	O_i	2	15	17
	E_i	8½	8½	17.

$$\chi^2 = 9.94 *$$

*Significant at 5% level.

PART 2 TABLES

Set 2 - Relationships between Items
in the Pre-test

(Contingency Tables)

N.B. Green = Observed frequency
Black = Observed corrected by Yates
Red = Expected frequency

A

B

RELATIONSHIP: SHAPE RECOGNITION/ELABORATION

A \ B	FAIL	PASS	TOTAL
FAIL	10 ^{9.5} <u>6.88</u>	1 ^{1.5} <u>4.12</u>	11
PASS	15 ^{16.5} <u>18.12</u>	14 ^{13.5} <u>10.88</u>	29
TOTAL	25	15	40

7 - 8 years.

$$\chi^2 = 3.69.$$

RELATIONSHIP:

A \ B	FAIL	PASS	TOTAL
FAIL	24 ^{23.5} <u>23.25</u>	7 ^{7.5} <u>7.75</u>	31
PASS	6 ^{6.5} <u>6.75</u>	3 ^{2.5} <u>2.25</u>	9
TOTAL	30	10	40

9 - 10 years.

$$\chi^2 = 0.048.$$

RELATIONSHIP:

A \ B	FAIL	PASS	TOTAL
FAIL	34 ^{33.5} <u>23.88</u>	8 ^{8.5} <u>13.12</u>	42
PASS	21 ^{21.5} <u>26.13</u>	17 ^{16.5} <u>11.87</u>	38
TOTAL	55	25	80

all

$$\chi^2 = 4.989$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

A

C

RELATIONSHIP: SHAPE RECOGNITION/RECON(1) PARTIALLY CORRECT.

A \ C	FAIL	PASS	TOTAL
FAIL	<u>26</u> ^{25.5} <u>22.48</u>	<u>5</u> ^{5.5} <u>2.53</u>	<u>31</u>
PASS	<u>3</u> ^{3.5} <u>6.52</u>	<u>6</u> ^{5.5} <u>2.48</u>	<u>9</u>
TOTAL	<u>29</u>	<u>11</u>	<u>40</u>

7 - 8 years.

$$\chi^2 = 6.566$$

RELATIONSHIP:

A \ C	FAIL	PASS	TOTAL
FAIL	<u>8</u> ^{7.5} <u>5.23</u>	<u>3</u> ^{3.5} <u>5.77</u>	<u>11</u>
PASS	<u>11</u> ^{11.5} <u>13.77</u>	<u>18</u> ^{17.5} <u>15.23</u>	<u>29</u>
TOTAL	<u>19</u>	<u>21</u>	<u>40</u>

9 - 10 years.

$$\chi^2 = 2.600$$

RELATIONSHIP:

A \ C	FAIL	PASS	TOTAL
FAIL	<u>34</u> ^{33.5} <u>25.2</u>	<u>8</u> ^{8.5} <u>16.8</u>	<u>42</u>
PASS	<u>14</u> ^{14.5} <u>22.8</u>	<u>24</u> ^{23.5} <u>15.2</u>	<u>38</u>
TOTAL	<u>48</u>	<u>32</u>	<u>80</u>

all.

$$\chi^2 = 14.388$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

A

D

430.

RELATIONSHIP: SHAPE RECOGNITION/RECON(2) Partially Correct.

A \ D	FAIL	PASS	TOTAL
FAIL	30 ^{29.5} <u>27.9</u>	1 ^{1.5} <u>3.1</u>	31
PASS	6 ^{6.5} <u>2.1</u>	3 ^{2.5} <u>0.2</u>	9
TOTAL	36	4	40

7 - 8 years.

$$\chi^2 = 4.078$$

RELATIONSHIP:

A \ D	FAIL	PASS	TOTAL
FAIL	10 ^{9.5} <u>8.52</u>	1 ^{1.5} <u>2.47</u>	11
PASS	21 ^{21.5} <u>22.47</u>	8 ^{7.5} <u>6.52</u>	29
TOTAL	31	9	40

9 - 10 years.

$$\chi^2 = 0.684$$

RELATIONSHIP:

A \ D	FAIL	PASS	TOTAL
FAIL	40 ^{39.5} <u>35.18</u>	2 ^{2.5} <u>6.82</u>	42
PASS	27 ^{27.5} <u>31.82</u>	11 ^{10.5} <u>6.18</u>	38
TOTAL	67	13	80

all.

$$\chi^2 = 6.876$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

B

C

431.

RELATIONSHIP: ELABORATION/RECON(1) Partially Correct.

B \ C	FAIL	PASS	TOTAL
FAIL	<u>25</u> ^{24.5} <u>21.75</u>	<u>5</u> ^{5.5} <u>7.25</u>	<u>30</u>
PASS	<u>4</u> ^{4.5} <u>7.25</u>	<u>6</u> ^{5.5} <u>2.25</u>	<u>10</u>
TOTAL	<u>29</u>	<u>11</u>	<u>40</u>

7 - 8 years.

$$\chi^2 = 5.058$$

RELATIONSHIP:

B \ C	FAIL	PASS	TOTAL
FAIL	<u>17</u> ^{16.5} <u>11.88</u>	<u>8</u> ^{8.5} <u>13.12</u>	<u>25</u>
PASS	<u>2</u> ^{2.5} <u>7.12</u>	<u>13</u> ^{12.5} <u>7.88</u>	<u>15</u>
TOTAL	<u>19</u>	<u>21</u>	<u>40</u>

9 - 10 years.

$$\chi^2 = 9.134$$

RELATIONSHIP:

B \ C	FAIL	PASS	TOTAL
FAIL	<u>42</u> ^{41.2} <u>33</u>	<u>13</u> ^{13.5} <u>22</u>	<u>55</u>
PASS	<u>6</u> ^{6.5} <u>15</u>	<u>19</u> ^{18.5} <u>10</u>	<u>25</u>
TOTAL	<u>48</u>	<u>32</u>	<u>80</u>

all.

$$\chi^2 = 17.515$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

B

D

432.

RELATIONSHIP: ELABORATION/RECONS.(1) PARTIALLY CORRECT.

B \ D	FAIL	PASS	TOTAL
FAIL	<u>28</u> ^{27.5} 27	<u>2</u> ^{2.5} 3	<u>30</u>
PASS	<u>8</u> ^{8.5} 9	<u>2</u> ^{1.5} 1	<u>10</u>
TOTAL	<u>36</u>	<u>4</u>	<u>40.</u>

7 - 8 years.

$$\chi^2 = 0.370.$$

RELATIONSHIP:

B \ D	FAIL	PASS	TOTAL
FAIL	<u>22</u> ^{21.5} <u>19.38</u>	<u>3</u> ^{3.5} <u>5.62</u>	<u>25</u>
PASS	<u>9</u> ^{9.5} <u>11.63</u>	<u>6</u> ^{5.5} <u>3.38</u>	<u>15</u>
TOTAL	<u>31</u>	<u>9</u>	<u>40</u>

9 - 10 years.

$$\chi^2 = 2.758$$

RELATIONSHIP:

B \ D	FAIL	PASS	TOTAL
FAIL	<u>50</u> ^{49.5} <u>46.05</u>	<u>5</u> ^{5.5} <u>8.95</u>	<u>55</u>
PASS	<u>17</u> ^{17.5} <u>20.45</u>	<u>8</u> ^{7.5} <u>4.05</u>	<u>25</u>
TOTAL	<u>67</u>	<u>13</u>	<u>80.</u>

all

$$\chi^2 = 4.921$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

C D

RELATIONSHIP: RECONST.(1) / RECONST.(2) Partially correct.

C \ D	FAIL	PASS	TOTAL
FAIL	28 ^{27.5} <u>26.1</u>	1 ^{1.5} <u>2.9</u>	29
PASS	8 ^{8.5} <u>9.9</u>	3 ^{2.5} <u>1.1</u>	11
TOTAL	36	4	40

7 - 8 years

$$\chi^2 = 2.73$$

RELATIONSHIP:

C \ D	FAIL	PASS	TOTAL
FAIL	18 ^{17.5} <u>14.73</u>	1 ^{1.5} <u>4.27</u>	19
PASS	13 ^{13.5} <u>16.27</u>	8 ^{7.5} <u>4.3</u>	21
TOTAL	31	9	40

9 - 10 years.

$$\chi^2 = 4.424$$

RELATIONSHIP:

C \ D	FAIL	PASS	TOTAL
FAIL	46 ^{45.5} <u>40.2</u>	2 ^{2.5} <u>7.8</u>	48
PASS	21 ^{21.5} <u>26.8</u>	11 ^{10.5} <u>5.2</u>	32
TOTAL	67	13	80

all.

$$\chi^2 = 10.75$$

KEY: Green = observed frequencies.

Black = observed frequencies corrected by Yates'.

Red = expected frequencies.

PART 2 TABLES

Set 3 - Relationships between Items in Post-test (Contingency tables)

N.B. Green = Observed frequency
Black = Observed corrected by Yates
Red = Expected Frequency

RELATIONSHIP: PARTIAL Success on both (1+2)
Restructuring TASKs

Age \ (1+2)	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	24	1	15	0	40
9 - 10	25	2	11	2	40
TOTAL	49	3	26	2	80

7 - 8 years

1 \ 2	FAIL	PASS	TOTAL
FAIL	23.5 24 24.4	0.5 1 .6	25
PASS	15.5 15 14.6	0.5 0 .4	15
TOTAL	39	1	40

$$\chi^2 = 0.043$$

9 - 10 years

1 \ 2	FAIL	PASS	TOTAL
FAIL	24.5 25 24.3	2.5 2 2.7	27
PASS	11.5 11 11.7	2.5 2 1.3	13
TOTAL	36	4	40

$$\chi^2 = 0.051$$

RELATIONSHIP: Both Re-structuring Tasks (1+2) Correct.

Age ^(EQ)	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	31	5	1	3	40
9 - 10	9	8	3	20	40
TOTAL	40	13	4	23	80.

7 - 8 years

1 \ 2	FAIL	PASS	TOTAL
FAIL	31 ^{30.5} _{28.8}	5 ^{5.5} _{7.2}	36
PASS	1 ^{1.5} _{3.2}	3 ^{2.5} _{.2}	4
TOTAL	32	8	40

$$\underline{\chi^2 = 5.02 *}$$

9 - 10 years

1 \ 2	FAIL	PASS	TOTAL
FAIL	9 ^{8.5} _{5.1}	8 ^{8.5} _{11.9}	17
PASS	3 ^{3.5} _{6.9}	2 ^{2.5} _{16.1}	23
TOTAL	12	28	40

$$\underline{\chi^2 = 5.63 *}$$

* Significant at 5% level.

PART 2 TABLES

Set 4 - Relationships between the
Transfer Task and all Others

(Contingency tests)

N.B. Green = Observed frequency
Black = Observed corrected by Yates
Red = Expected frequency

RELATIONSHIP: TRANSFER + SHAPE RECOGNITION

Age \ SR+T	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	31	0	7	2	40
9 - 10	10	1	16	13	40
TOTAL	41	1	23	15	80.

7 - 8 years

SR \ T	FAIL	PASS	TOTAL
FAIL	31 30.5 29.5	0 0.5 1.6	31
PASS	2 27.5 8.6	2 1.5 0.45	9
TOTAL	38	2	40

$$\chi^2 = 3.38$$

9 - 10 years

SR \ T	FAIL	PASS	TOTAL
FAIL	10 9.5 7.2	1 1.5 2.85	11
PASS	16 16.5 12.85	13 12.5 10.15	29
TOTAL	26	14	40

$$\chi^2 = 3.01.$$

RELATIONSHIP: ELABORATION + TRANSFER

Age $E+T$	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	29	1	9	1	40
9 - 10	20	5	5	10	40
TOTAL	49	6	14	11	80

7 - 8 years

$E \backslash T$	FAIL	PASS	TOTAL
FAIL	29 ^{28.5} 29 28.5	1 ^{1.5} 1 1.5	30
PASS	9 ^{9.5} 9 9.5	1 ^{0.5} 1 0.5	10
TOTAL	38	2	40

$$\underline{\chi^2 = 0.0}$$

9 - 10 years

$E \backslash T$	FAIL	PASS	TOTAL
FAIL	20 ^{19.5} 20 19.5	5 ^{5.5} 5 5.5	25
PASS	5 ^{5.5} 5 5.5	10 ^{9.5} 10 9.5	15
TOTAL	25	15	40

$$\underline{\chi^2 = 6.83 *}$$

* Significant at 1% level.

RELATIONSHIP: PARTIAL SUCCESS ON RECON(1) PRETEST
AND TRANSFER.

Age \ PS+T	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	29	0	8	3	40
9 - 10	18	1	7	14	40
TOTAL	47	1	15	17	80

7 - 8 years

PS \ T	FAIL	PASS	TOTAL
FAIL	29 $\frac{28.5}{26.83}$	0 $\frac{0.5}{2.18}$	29
PASS	8 $\frac{8.5}{10.18}$	3 $\frac{2.5}{2.25}$	11
TOTAL	37	3	40

$$\underline{\chi^2 = 5.08 *}$$

9 - 10 years

PS \ T	FAIL	PASS	TOTAL
FAIL	18 $\frac{17.5}{11.88}$	1 $\frac{1.5}{7.13}$	19
PASS	7 $\frac{7.5}{13.13}$	14 $\frac{13.5}{7.88}$	21
TOTAL	25	15	40.

$$\underline{\chi^2 = 13.53. **}$$

* Significant at 5% level.

** Significant at 1% level.

RELATIONSHIP: PARTIAL Success on Recon (2) [PRETEST]
and TRANSFER.

Age \ P.2+T	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	36	0	2	2	40
9 - 10	24	7	2	7	40
TOTAL	60	7	4	9	80

7 - 8 years

PS \ T	FAIL	PASS	TOTAL
FAIL	36 ^{35.5} 36 34.2	0 ^{0.5} 0 1.8	36
PASS	2 ^{2.5} 2 3.8	2 ^{1.5} 2 .2	4
TOTAL	38	2	40

$$\underline{\chi^2 = 9.88 *}$$

9 - 10 years

PS \ T	FAIL	PASS	TOTAL
FAIL	24 ^{24.5} 24 27.9	7 ^{7.5} 7 10.25	31
PASS	2 ^{2.5} 2 5.25	7 ^{6.5} 7 3.15	9
TOTAL	26	14	40

$$\underline{\chi^2 = 6.93 *}$$

* Significant at 1% level.

RELATIONSHIP: RECONSTRUCTION I [A-B-T TEST] CORRECT
+ TRANSFER.

Age $R+T$	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	36	0	2	2	40
9 - 10	16	1	9	14	40
TOTAL	52	1	11	16	80

7 - 8 years

$R \backslash T$	FAIL	PASS	TOTAL
FAIL	$36 \begin{smallmatrix} 35.5 \\ 34.2 \end{smallmatrix}$	$0 \begin{smallmatrix} 0.5 \\ 1.2 \end{smallmatrix}$	36
PASS	$2 \begin{smallmatrix} 2.5 \\ 3.4 \end{smallmatrix}$	$2 \begin{smallmatrix} 1.5 \\ 2 \end{smallmatrix}$	4
TOTAL	38	2	40

$$\underline{\chi^2 = 9.68 *}$$

9 - 10 years

$R \backslash T$	FAIL	PASS	TOTAL
FAIL	$16 \begin{smallmatrix} 15.5 \\ 16.63 \end{smallmatrix}$	$1 \begin{smallmatrix} 1.5 \\ 5.95 \end{smallmatrix}$	17
PASS	$9 \begin{smallmatrix} 9.5 \\ 14.38 \end{smallmatrix}$	$14 \begin{smallmatrix} 13.5 \\ 8.63 \end{smallmatrix}$	23
TOTAL	25	15	40

$$\underline{\chi^2 = 9.96 *}$$

* Significant at 1% level.

RELATIONSHIP: PARTIAL Success on Recons/Function (E) [Post Test]
With TRANSFER.

Age \backslash PS+T	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	24	14	2	0	40
9 - 10	13	14	12	1	40
TOTAL	37	28	14	1	80

7 - 8 years

\backslash PS T	FAIL	PASS	TOTAL
FAIL	24 ^{24.5} 24 24.7	14 ^{13.5} 14 13.3	38
PASS	2 ^{1.5} 2 1.3	0 ^{0.5} 0 0.7	2
TOTAL	26	14	40

$$\underline{\chi^2 = 0.035.}$$

9 - 10 years

\backslash PS T	FAIL	PASS	TOTAL
FAIL	13 ^{13.5} 13 16.22	14 ^{13.5} 14 10.13	27
PASS	12 ^{11.5} 12 8.13	1 ^{1.5} 1 4.88	13
TOTAL	25	15	40

$$\underline{\chi^2 = 5.54 *}$$

* Significant at 1% level.

RELATIONSHIP: Reconstruction (2) POST-TEST CORRECT
AND TRANSFER.

Age \backslash R2+T	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	32	0	6	2	40
9 - 10	12	0	13	15	40
TOTAL	44	0	19	17	80

7 - 8 years

\backslash T	FAIL	PASS	TOTAL
R2			
FAIL	32 $\begin{smallmatrix} 31.5 \\ 30.4 \end{smallmatrix}$	0 $\begin{smallmatrix} 0.5 \\ 1.6 \end{smallmatrix}$	32
PASS	6 $\begin{smallmatrix} 6.5 \\ 7.6 \end{smallmatrix}$	2 $\begin{smallmatrix} 1.5 \\ 0.4 \end{smallmatrix}$	8
TOTAL	38	2	40

$$\underline{\chi^2 = 3.98}$$

9 - 10 years

\backslash T	FAIL	PASS	TOTAL
R2			
FAIL	12 $\begin{smallmatrix} 11.5 \\ 7.5 \end{smallmatrix}$	0 $\begin{smallmatrix} 0.5 \\ 4.5 \end{smallmatrix}$	12
PASS	13 $\begin{smallmatrix} 14.5 \\ 17.5 \end{smallmatrix}$	15 $\begin{smallmatrix} 14.5 \\ 10.5 \end{smallmatrix}$	28
TOTAL	25	15	40

$$\underline{\chi^2 = 7.73 *}$$

* Significant at 1% level.

RELATIONSHIP: PARTIAL SUCCESS ON RECON (2) Post Test
and TRANSFER.

Age $\begin{matrix} \text{PS} \\ \text{T} \end{matrix}$	(0.0.)	(0.1.)	(1.0.)	(1.1.)	TOTAL.
7 - 8	37	2	1	0	40
9 - 10	23	15	2	0	40
TOTAL	60	17	3	0	80

7 - 8 years

$\begin{matrix} \text{PS} \\ \text{T} \end{matrix}$	FAIL	PASS	TOTAL
FAIL	37 $\begin{matrix} 36.5 \\ 37.05 \end{matrix}$	2 $\begin{matrix} 1.5 \\ 1.95 \end{matrix}$	39
PASS	1 $\begin{matrix} 1.5 \\ .05 \end{matrix}$	0 $\begin{matrix} 0.5 \\ .05 \end{matrix}$	1
TOTAL	38	2	40

$$\underline{\chi^2 = 4.37 *}$$

9 - 10 years

$\begin{matrix} \text{PS} \\ \text{T} \end{matrix}$	FAIL	PASS	TOTAL
FAIL	23 $\begin{matrix} 22.5 \\ 23.25 \end{matrix}$	15 $\begin{matrix} 15.5 \\ 14.25 \end{matrix}$	38
PASS	2 $\begin{matrix} 2.5 \\ 1.25 \end{matrix}$	0 $\begin{matrix} 0.5 \\ 0.75 \end{matrix}$	2
TOTAL	25	15	40

$$\underline{\chi^2 = 0.14.}$$

* Significant at 5% level.

PART 2 TABLES

Set 5 - Improvement in Performance
(as a result of training)

RELATIONSHIP: RECON.(1) Partly Correct (Pre-test) / $\begin{matrix} C \\ E \end{matrix}$
 RECON.(1) Wholly Correct (Post-test) $\begin{matrix} C \\ E \end{matrix}$

$C \backslash E$	FAIL	PASS	TOTAL
FAIL	$\begin{matrix} 29^{28.5} \\ -12.9 \end{matrix}$	$\begin{matrix} 0^{0.5} \\ -2.1 \end{matrix}$	21
PASS	$\begin{matrix} 7^{7.5} \\ -2.1 \end{matrix}$	$\begin{matrix} 4^{3.5} \\ -3.9 \end{matrix}$	11
TOTAL	36	4	40

7 - 8 years

$$\chi^2 = > 6.6$$

RELATIONSHIP: C/E

$C \backslash E$	FAIL	PASS	TOTAL
FAIL	$\begin{matrix} 13^{12.5} \\ -8.08 \end{matrix}$	$\begin{matrix} 6^{6.5} \\ -10.92 \end{matrix}$	19
PASS	$\begin{matrix} 4^{4.5} \\ -8.92 \end{matrix}$	$\begin{matrix} 17^{16.5} \\ -12.08 \end{matrix}$	21
TOTAL	17	23	40.

9 - 10 years.

$$\chi^2 = > 6.6.$$

RELATIONSHIP: RECON(2) Partially Correct (Pretest) D
 Recon(2) Wholly Correct (Post-test) G

<u>D \ G</u>	FAIL	PASS	TOTAL
FAIL	32 ^{31.5} <u>12.12</u>	4 ^{4.5} <u>10.88</u>	36
PASS	1 ^{1.5} <u>6.88</u>	3 ^{2.5} <u>4.12</u>	4
TOTAL	33	7	40

7-8 years

$$\chi^2 = 6.23$$

RELATIONSHIP:

DG

<u>D \ G</u>	FAIL	PASS	TOTAL
FAIL	12 ^{11.5} <u>9.3</u>	19 ^{19.5} <u>21.7</u>	31
PASS	0 ^{0.5} <u>2.7</u>	9 ^{8.5} <u>6.3</u>	9
TOTAL	12	28	40.

9 - 10 years.

$$\chi^2 = 3.30.$$

RELATIONSHIP: RECONSTR.(1) Partially Correct (Pretest) C
 " " " " (Posttest) F

$C \backslash F$	FAIL	PASS	TOTAL
FAIL	21 $\begin{smallmatrix} 20.5 \\ 13.12 \end{smallmatrix}$	8 $\begin{smallmatrix} 8.5 \\ 10.88 \end{smallmatrix}$	29
PASS	4 $\begin{smallmatrix} 4.5 \\ 6.88 \end{smallmatrix}$	7 $\begin{smallmatrix} 6.5 \\ 4.12 \end{smallmatrix}$	11
TOTAL	25	15	40

7 - 8 years.

$$\chi^2 = 2.99$$

RELATIONSHIP: C/F

$C \backslash F$	FAIL	PASS	TOTAL
FAIL	10 $\begin{smallmatrix} 9.5 \\ 12.8 \end{smallmatrix}$	9 $\begin{smallmatrix} 9.5 \\ 6.12 \end{smallmatrix}$	19
PASS	17 $\begin{smallmatrix} 17.5 \\ 14.12 \end{smallmatrix}$	4 $\begin{smallmatrix} 3.5 \\ 6.32 \end{smallmatrix}$	21
TOTAL	27	13	40.

9 - 10 years.

$$\chi^2 = 2.470.$$

RELATIONSHIP: Reconstrect.(2) Partially Correct (Pretest) D/H
 " " " " (Posttest)

D \ H	FAIL	PASS	TOTAL
FAIL	36 ^{35.5} <u>35.1</u>	0 ^{0.5} <u>.9</u>	36
PASS	3 ^{3.5} <u>3.9</u>	1 ^{0.5} <u>.1</u>	4
TOTAL	39	1	40

7 - 8 years.

$$\chi^2 = 1.82$$

RELATIONSHIP: D/H

D \ H	FAIL	PASS	TOTAL
FAIL	27 ^{26.5} <u>27.9</u>	4 ^{4.5} <u>3.1</u>	31
PASS	9 ^{9.5} <u>8.1</u>	0 ^{0.5} <u>0.9</u>	9
TOTAL	36	4	40

9 - 10 years.

$$\chi^2 = 0.255$$

INTERPRETATION OF RESULTS

Analysis of Variance (Standard F Tests)

Sex and Age (Table 1, Part 2)

Age

Analysis of variance tests were carried out on pre-test and post-test items, to test for significant variation between sexes and between age groups (7-8 years and 9-10 years). The following tasks all showed similar results, in as much as giving significant results for ages.

- | | | |
|--|---|-----------|
| A. Shape Recognition Correct. (1% level) | } | pre-test |
| C. Re-structuring (1) Partially Correct (5% level) | | |
| • E. Re-structuring (1) Correct (1% level) | } | post-test |
| G. Re-structuring (2) Correct (1% level) | | |
| I. Transfer Task Correct (1% level) | | |

The remaining tasks:

- | | | |
|---|---|-----------|
| B. Elaboration | } | pre-test |
| D. Re-structuring (2) Partially Correct | | |
| F. Re-structuring (1) Partially Correct |) | post-test |

gave neither factor as being significant.

Sex

Task H - Re-construction (2) post-test - gave a significant sex effect at the 2.5% level, however, only 5 subjects passed this task (all boys so the reliability of the result could be questioned. Generally, there were no significant differences in performance between the boys and girls.

Complementary χ^2 goodness-of-fit tests for differences between age-groups (ignoring sex) gave the following results:

Pre-Test : Differences between the two age-groups		
A. Shape Recognition	$\chi^2 = 9.01$	Significant at 0.5% level
B. Elaboration	$\chi^2 = 0.64$	Not significant
C. Re-structuring (1) Partially correct	$\chi^2 = 2.83$	Significant at 10% level
D. Re-structuring (2) Partially correct	$\chi^2 = 1.23$	Not significant

Post-Test : Differences between the two age-groups		
E. Re-structuring (1) Correct	$\chi^2 = 13.42$	Significant at 0.5% level
F. Re-structuring (1) Partially correct	$\chi^2 = 0.143$	Not significant
G. Re-structuring (2) Correct	$\chi^2 = 11.11$	Significant at 0.5% level
H. Transfer Task Correct	$\chi^2 = 9.94$	Significant at 0.5% level

Task H - "Re-structuring (2) - partially correct" - was not suitable for this test owing to the very small numbers passing it.

• These results tend to bear out the results of the first analysis of variance. It appears that the tasks A.C.E.G.I. are giving significant results for age variation (between the two groups 7-8 and 9-10). Such variation was anticipated and has important consequences for training and improvement (as will be seen later).

Differences between pre-test and post-test performance should also be noted, in terms of improvement in performance. In the pre-test, the main significant difference was on the Shape Recognition Task (0.5% level). No subject was achieving total success on either of the Re-construction

Tasks (1 and 2), and there was no significant difference for age on "partial success" for either of these two tasks. In the post-test, however, subjects begin to pass the Re-structuring tasks (E and F) and there are significant differences in performance for age (0.5% level). The same comments apply to the Transfer Task (I). It might be concluded therefore that with age, subjects show more ability to profit from the training.

It will be noticed that Task F (Re-structuring (1)) is the only task for which the total number of passes actually decreases with age. (7-8 years = 15 passes; 9-10 years = 13 passes). This is not surprising since more of the younger subjects are likely to satisfy this level of the item (which requires only "partial success") and more of the older subjects are likely to pass E, which requires complete success on the same task. The same explanation applies to tasks G and H. Task B (Elaboration) was not significant.

Conclusion

Generally, no difference between the performances of the boys and girls was anticipated and no significant difference was found. In this sense, therefore, there is coherence in the second battery of tasks in that they do not seem to favour any one sex. As all subjects selected for the training programme "failed" or "partly failed" both Re-construction Tasks, no significant difference in performance on the basis of age could have been anticipated, except in differences relating to partial success on both of these tasks. Significance for partial success on the pre-test was found on only one Re-construction Task (Task 1) (10% level).

What is perhaps more important is that complete success on both of these central (Re-construction) training tasks gave significant results for ages in the post-test suggesting that the older subjects who were generally more capable of "partial success" in the pre-test, were, because of this initial degree of success, more likely to benefit from training.

Such findings are in keeping with the underpinning theory, which would regard subjects who made this type of progress as being on the brink of a new stage of understanding, and as such, able to benefit from training of this type.

RELATIONSHIPS BETWEEN ITEMS IN THE PRE-TEST (Tables Set 2)

The analysis of inter-dependence of items in this second part of the research is interesting in relation to the analysis in part one. The task items in this second part are based upon the same principles and task inter-dependency is expected theoretically.

As the analysis of variance gave significant age-effects it was felt appropriate to split up this analysis between the two age-groups. X_2 tests were carried out between each pair of tasks within the pre-test to determine independence. (H_0 = Tests are independent.)

The pre-test tasks were:

- A. Shape Recognition
- B. Elaboration
- C. Re-structuring (1) partially correct
- D. Re-structuring (2) partially correct

The values obtained were as follows:

Test Pairs	7-8 years	9-10 years
AB	$X_2 = .43$	$X_2 = 4.26$ sig. at 5% level
AC	$X_2 = 6.57$ sig. at 5% level	$X_2 = 2.6$
AD	$X_2 = 4.08$ sig. at 5% level	$X_2 \leq 1.57$
BC	$X_2 = 5.06$ sig. at 5% level	$X_2 = 9.13$ sig. at 1% level
BD	$X_2 \leq 1.48$	$X_2 = 2.75$
CD	$X_2 = 2.73$	$X_2 = 4.42$ sig. at 5% level

However, it should be pointed out that the results for the older age group are more meaningful in the sense that the pass rate was very low for the younger age group. In fact, in terms of task dependence, values for these age bands require cautious analysis (as indicated in Part 1 of the research) either because of the low pass rate in the younger group or because the older subjects are argued to be in a 'transitional stage' in terms of ability and are thus likely to be inconsistent in their responses.

Tasks A and B would be expected to associate (they do for older age group - 5% level) but because Tasks C and D require only partial success - i.e. are assumed to have a different level of task competence, they would not be expected to associate with Tasks A and B. It is interesting to note therefore that Task C does associate with tasks requiring complete success:

Task C associates with Task B (older age group only) - 1% level

Task C associates with Task A (younger age group only) - 5% level

This association is a comment on either:

- a) Incorrect identification of task levels for Tasks A and B or C itself.

- b) The unpredictability of the older group because they are assumed to fall into a transitional stage (i.e. between major stages of ability).
- c) In the case of the younger subjects - the low response rate which leads to a less meaningful association.

Further empirical investigation would be required to isolate the inconsistency.

RELATIONSHIPS BETWEEN POST-TEST ITEMS (Tables Set 3)

Again, the results were split into ages and tested by a contingency table for independence between each of the pairs:

- | | |
|---------------------------------------|--|
| E. Re-structuring (1) correct.
and | F. Re-structuring (1) partially
and correct |
| G. Re-structuring (2) correct | H. Re-structuring (2) partially
correct |

Test Pair	7-8 years	9-10 years
EG	$\chi^2 = 5.02$ (5% level)	$\chi^2 = 5.63$ (5% level)
FH	$\chi^2 = 0.04$	$\chi^2 = 0.05$

As with the last analysis, the tables for FH gave quite small values which may tend to make the test more conservative and inclined to accept the hypothesis of independence. It is useful to note the (empirical) probabilities for passing Tests E and G.

$$P(\text{passing test E, G, at 7-8 years}) = 0.075$$

$$P(\text{passing test E, G, at 9-10 years}) = 0.5$$

Such should be borne in mind when interpreting task association.

Tasks E and G would be expected to associate because they require complete success based on a firm understanding. Tasks F and H are not as likely to associate, for they require only partial success on the tasks, and speak of a less firm understanding, and perhaps less consistent ability.

RELATIONSHIPS BETWEEN THE TRANSFER TASK AND THE REST (Tables Set 4)

Contingency table results testing for independence :

(I = Transfer Task)

Tasks	7-8 years	9-10 years
AI	$X_2 = 3.38$	$X_2 = 3.01$
BI	$X_2 = 0$	$X_2 = 6.83$ sig. 1% level
CI	$X_2 = 5.08$ sig. 5% level	$X_2 = 13.53$ sig. 1% level
DI	$X_2 = 9.88$ sig. 1% level	$X_2 = 6.93$ sig. 1% level
EI	$X_2 = 9.68$ sig. 1% level	$X_2 = 9.96$ sig. 1% level
FI	$X_2 = 0.03$	$X_2 = 5.54$ sig. 5% level
GI	$X_2 = 3.98$ sig. 5% level	$X_2 = 7.73$ sig. 1% level
HI	$X_2 = 4.37$ sig. 5% level	$X_2 = 0.14$

The point should perhaps be made in interpreting association between items that logically, as already indicated, all items would not be expected to associate. E.g. "partial - success" on a post-test item (F and H) is not expected to associate with complete success on the transfer task (I). In both instances, significance is shown for only one age group, and some of this association could be explained in terms of a low-response for both tasks. This expected lack of association is because "partial success" indicates a limited level of understanding and for transfer of ability to be demonstrated a grasp of the logic of the task (complete success) is assumed to be essential. On the other hand, complete success (E and G) in the post-test, would be expected to associate more with the Transfer task. In fact, it does so in all instances. From this analysis it can be concluded that there is generally high association between the transfer task and those tasks which would be expected to associate with it. The

exception is Task A, where significance was not shown for either age group. Tasks C to G are associated with Task I for all ages. As indicated, Task A (Shape Recognition) is not associated with the transfer task, and Task B associates at the older age level only. Tasks F and H would not be expected to associate with I, but each does, though at one age level only.

It would be reasonable to conclude that the analysis demonstrates a good degree of internal consistency within the task battery.

Improvement in performance as a result of training (Tables Set 5)

Questions to be put in the light of the attempt to improve performance by training were:

- a) Would subjects who had partially succeeded on the Re-structuring Tasks be wholly successful on these tasks after training?
- b) And, of course, (as previously considered (Tables Set 4)), could they transfer understanding to another task, different in presentation, but based upon the same principles?

<u>Tasks:</u>	C. Partial success on Re-structuring (1)	}	pre-test
	D. Partial success on Re-structuring (2)		
	E. Re-structuring (1) correct	}	post-test
	F. Re-structuring (1) partially correct		
	G. Re-structuring (2) correct		
	H. Partial success on Re-structuring (2)		

A first step was to test for independence between tests C E F
and tests D G H

Findings were as follows:

Test Pair	7-8 years	9-10 years
CE	$X_2 = 10.$ sig. 1% level	$X_2 = 9.$ sig. 1% level
CF	$X_2 = 2.99$	$X_2 \leq 3.$
DG	$X_2 = 6.23$ sig. 1% level	$X_2 = 3.3$
DH	$X_2 = 1.82$	$X_2 = 1.2$

CE were expected to associate, for success on E, the same task at a higher level (in the post-test) is thought to be more likely if the subject showed "partial success" (c) on the task in the pre-test. C and F were not expected to associate (and did not). Had they done so, there would have been no indication of improvement for this Re-structuring task (1). (E and F could obviously not associate for they represent different achievement levels on the same task.) These same comments apply to D and G, and to D and H.

A clear conclusion is that for both Re-construction Tasks (1) and (2) improvement (total success) is dependent upon partial success in the pre-test.

As with all other cases, the contingency tables had values less than 5, which throws into question the reliability of the findings.

After interpreting probabilities of passing the tests, the following conclusions can be drawn:

a) Given a pass at C, the probability of passing E was increased for both age groups.

7-8 years: $P(\text{passing E}) = 0.1$; $P(\text{passing E}/\text{passed C}) = 0.364$

9-10 years: $P(\text{passing E}) = 0.575$; $P(\text{passing E}/\text{passed C}) = 0.810$

b) Given a fail at C, the probability of passing F decreases for both age groups.

7-8 years: $P(\text{passing F}) = 0.375$; $P(\text{passing F}) P(\text{fail C}) = 0.276$

9-10 years: $P(\text{passing f}) = 0.325$; $P(\text{passing F}) P(\text{fail C}) = 0.143$

c) Given a pass at D, the probability of passing G increases for both age groups:

7-8 years: $P(\text{passing G}) = 0.2$; $P(\text{passing G/pass D}) = 0.75$

9-10 years: $P(\text{passing G}) = 0.7$; $P(\text{passing G/pass D}) = 1.00$

d) Given a fail for D, the probability of passing H decreases for both age groups:

7-8 years: $P(\text{passing H}) = 0.025$; $P(\text{passing H and failing D}) = 0.0225$

9-10 years: $P(\text{passing H}) = 0.1$; $P(\text{passing H and failing D}) = 0.0775$

CONCLUSION

The obvious conclusion, as was anticipated from a theoretical formulation, is that training does not seem able to move subjects from one stage of understanding to another. Where a subject is on the brink of understanding (partial success) training would seem to be effective. Subjects coming to the training experience unable to attain partial success on a pre-test task are less likely to improve - in terms of attaining partial success on the post-test - than subjects who are already partially successful on the pre-test and able to profit thereby from this initial level of understanding.

One remaining question could be - how does one move a subject from no understanding to partial or whole understanding of an identity and its transformations? Piaget's scepticism on this issue is well known - yet within life's learning context such transitions do take place. The problem remains of trapping the actual moment of meaningful, transitional experience so as to better understand the mechanisms involved.

Such training attempts are interesting and useful for they at least suggest that there are stages of understanding in the re-construction of reality.

Chapter 11

QUANTIFYING THE QUALITATIVE:
AN EVALUATION

"In science we are compelled to investigate before we know what we are investigating, and as our knowledge increases we must continually re-state our questions." (Haldane, 1932)

Any method of assessment must find its explanation in initial starting concepts and assumptions. Assessment might well be seen as a way of checking initial hypotheses. This may appear to be a strikingly obvious statement, but the attraction of sophisticated programmes of analysis can sometimes encourage one to believe that it is at the final point in the assessment process that patterns and relationships are to be explained. It is at this point that patterns and relationships are to be described and verified.

Cattell (1971) discussing this point in relation to factor analysis made it clear that the factor analyst, or any analyst, cannot simply accept the existence of relationships on a statistical basis; he must proceed to understand and explain such relationships. Cattell comments that this is most usually done by:

"... creating a framework of subjective-philosophical-logical categories - on present data indications, according to one's favoured logic."

In other words, assessment is a movement from inspirational hunches to increasingly sophisticated analysis, then back to the inspiration in the light of the analysis. The starting point is one of real subjectivity. George Kelly (1953) explaining the assumptions underpinning his personal construct theory stated quite simply that one either accepted his assumptions or found another theory perhaps more compatible with one's philosophy of man!

Haldane, (1932) The Causes of Evolution. P.63.

Cattell, R. (1971) Abilities: their Structure, Growth and Action. P.54

Kelly, G. (1955) A Theory of Personality: The Psychology of Personal Constructs.

Definitions are drawn up in the light of such initial assumptions. Problems of definition in relation to creativity have already been discussed in this study, but at this stage of evaluation, it may be of interest to consider them further in a wider framework.

A problem which besets much assessment of human behaviour is that of the often covert nature of the behaviour. If nothing else, this can produce a scarcity of operational definitions. In creativity and related areas, attempts at assessment have been made by means of indirect measures, measures akin to projective clinical techniques. Weisskopf (1950) and Singer et al (1955) investigating imagination, proposed a measure called the Transcendence Index:

"Essentially this method calls for an examination of the protocol in terms of what elements have been introduced which were not directly given by the objective stimulus."

Such measures are not unlike those employed, for instance, by Wallach & Kogan (1965). One disadvantage is that they involve a high level of interpretation on the part of those assessing. Similar problems could be cited regarding Klinger's (1969) work on phantasy which he defined as:

"Verbal reports of all mentation whose ideational products are not evaluated by the subject in terms of their usefulness in advancing some immediate goal extrinsic to the mentation itself."

From the days of psychophysics, such approaches have been criticised for lack of objectivity, reliability, etc. The intention is clearly to trap an 'inside process' in definitions and assessments. As with much assessment of intelligence and creativity, the conclusions are inferential statements, and everything depends upon the validity of such inferences.

Weisskopf, E.A. "A transcendence index as a proposed measure", J. of Psy. 1950, 29, 379-90.

Singer, J and Sugarman, D. (1955) "Some TAT correlates of Rorschach Human Movement Responses", J. of Consulting Psy. 12, 117-9.

Klinger, E. (1969) "Development of imaginative behaviour: implications of play for a theory of fantasy", Psy. Bull 4, 72, 277-98.

Initial conceptions might well be modified in the search for an operational definition; the attempt to present starting concepts in clear, measurable states might lead to avoidance of the actual complexities of covert behaviours. It may be intellectually more honest to admit that at this point in research time, some forms of behaviour are more open to research than are others. Skinner (1973) notes:

"There is a sense in which it can be said that the methods of science have scarcely been applied to human behaviour... we have counted and measured and compared; but something essential to scientific practice is missing in almost all current discussions of human behaviour. It has to do with our treatment of the causes of human behaviour." P.7.

Though operating within a different framework, Skinner's distinction is of importance to this discussion because it expresses the difference between approaches to problems which are essentially descriptive, and those which are concerned to explain. Such a distinction must have implications for initial operational definitions and for the construction of measures.

It has already been explained that creativity has to be understood in relation to culture. Thought is formed within a culture and ideas about what is normative are fundamentally cultural matters. Culture posits problems both in terms of initial definitions and items for assessment.

A pattern of cross-cultural Piagetian-based research has been to apply measures constructed within Western culture to non-Western cultures. Such measures have not been presented simply in styles and contexts foreign to non-Western subjects, but in addition the logics underpinning the measures have been Western logics. Ideally, what is needed is a Piagetian-type clinical searching among non-Western thought-patterns to

establish, through measures reflecting their own realities (and not modified Western realities) what their logics might be about - should they be discovered to be unlike Western logics. Greenfield's work (1966) with Wolof children suggests that schooling plays a vital part in cognitive styles, which suggests that schooling, as one kind of experience, is not simply a tool for performance acceleration but a tool for affecting cognitive styles.

In assessing Piaget's comments on the role of culture, it is important to point out that his explanation of growth, which is interactional and not purely maturational, does not rule out this cultural variation, though at times it might appear to do so (1966 and 1971).

Essentially, what is required for creativity is the ability to treat knowledge objectively, to be able to reflect upon it and upon its organisation. Whilst the cognitive styles may vary from culture to culture, and whilst cultural realities equally may vary, it would seem reasonable to suggest, on the basis of Piagetian cross-cultural research, that whatever the cultural context, knowing passes from ego-centric non-organisation to a state of increased objectivity and organisation. In this sense, Piaget is justified in claiming universality for his stages, though as yet it would be difficult to insist upon universality in terms of the nature of structures, for structures must be affected by the cultural content upon which they operate. Similarly attainment rates must vary. Piagetian assessment is directed to the 'how' of organising, not to the 'what' of organising - a brief which is very appropriate to cross-cultural investigation.

Greenfield, P.M. (1966) "On culture and conservation" in: Bruner, J.S. et al, Studies in Cognitive Growth.

Piaget, J. (1966) "Need and significance of cross cultural studies in genetic psychology", Internat. J. of Psy. 1. pp 3-13.

Piaget, J. (1971) Structuralism.

Within any culture, thought and action become increasingly organised. Whatever the cultural manifestation, schemas can be performed with increasing consciousness, action can eventually be repeated, modified, reversed, etc. Cognitive organisation is not tied to 'test-items'. Cognitive organisation applies to everyday thought, and items can be drawn from such ordinary contexts. Piaget himself has moved from the street and marble games, through kindergarten classrooms to more test-like situations.

It might be argued that with Piagetian assessment, the problems are not so much those of trying to find 'items' as the problem of attempting to order measures into some kind of system. On standardisation and systematisation Piaget has shown the greatest caution:

"A scientific epistemology, like any other discipline which is at the same time inductive and deductive, can only proceed step by step, through the gradual accumulation of partial results and without expecting too much too soon. It is from an uninterrupted series of well defined studies on individual topics that relationships should arise and generalisations emerge, not from a system set up in advance... The great danger is that of building too fast and of succumbing, after the first tentative steps, to the seduction of old habits of systematisation." (1972)

Inhelder (1969) has described Genevan type interaction in assessment:

"Our experiments have nothing to do with tests, but tend to be an exchange of views, a relatively unstructured conversation... in most tests, the child, once given the instructions, finds himself in front of problems to be solved. In our method the examiner must adapt himself to each case in order to stimulate the child, follow the lines of his thought and at the same time direct it to the crucial points." (1969)

Smedslund (1969) has already noted the hazards of such an approach, but it is believed that as a method it offers excellent possibilities for what might be termed "early pilot work". Given that such a flexible method might be early employed, what possibilities exist for standardisation?

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- Piaget, J. (1972) Psychology & Epistemology: Towards a Theory of Knowledge. P.69
 Inhelder, B. (1969) The Diagnosis of Reasoning in the Mentally Retarded. P.282.
 Smedslund, (1969) "Psychological diagnostics", Psy.Bull. 71. pp 237-48.

Standardisation is usually taken to mean that assessment procedures and conditions are so constructed and controlled that precisely the same testing procedures can be followed at different times and in different places. Tuddenham (1971) makes an important point when he notes that Piaget may standardise the questions but not necessarily the responses. In fact Piaget does not want standardised responses. However, to classify responses, to impose some order after the event, is possible. Strictly speaking, no assessment, psychometric or otherwise, can standardise its responses, in that it cannot wholly oblige the respondent to answer within the confines of the possible responses offered. "Rightness" or "wrongness" are important categories in Piagetian assessment, and both can be explained in terms of organisation or the lack of it. Given adequate groundwork therefore, there is no reason why responses could not be classified along a continuum of organisation.

To speak of a continuum of organisation is to raise questions concerning scaling and the concept of stage, often in an interrelated way. On the matter of scaling Piaget has commented:

"The object... initially, was not to establish a scale of development and to obtain precise determination of age as regards stages. It was a question of trying to understand the intellectual mechanisms used in the solution of problems and of determining the mechanisms of reasoning."

In these same discussions Piaget was challenged by Zazzo who suggested that the difficulty in establishing a precise age for the Piagetian stages was a result not only of a widespread dispersion but also of the fact that:

"In certain cases an isolated activity does not enable us to obtain the same results as when a mosaic-type test is used."

Tuddenham, R.D. "Theoretical regularities and individual idiosyncracies" in: Measurement and Piaget, Green, D. et al. (1971)
 Piaget, J. (1956) in: Discussions on Child Development, Vol 1, P.89.

Inhelder defended the challenge arguing that generally the dispersion within a stage was relatively small compared with the wide differences between behaviour in one stage or another. She continues with an anticipated Piagetian reply:

"In the present state of our research we are not able to say: 'such and such a child is exactly at the level of nine months'. However, I wonder if the compensations operating in mosaic type tests are any more than compensations of a statistical order and whether they reveal the essential characteristics of an age level?"

Piaget (1971) has made it clear that he could not be satisfied with scales or classifications that merely specify the dominant characteristics of a stage (see Freud for contrast here). Instead, he is concerned to discover overall structures of cognition and to avoid the 'dominant characteristics' approach. Uzgiris and Hunt (1966) working on object concept developed a set of items to form an ordinal scale after the type of a Guttman scale. They focussed on identifying levels or landmarks rather than seriously accepting the notion of stage. By contrast, Corman and Escalona (1969) accept the concept of stage as explained by Piaget and constructed a set of items to represent each stage in the attainment of object-concept. They identified the infant as being at a particular stage in terms of whether he passed a certain number of the items relevant to a particular stage and none of the items relevant to the following stage. Corman and Escalona expected the stages to be ordinal, but they did not expect all the items within a stage to fall into an ordinal scale of difficulty. Nivette (1971) commenting on Piaget's own assessment procedures notes that whilst the stages themselves might be

Inhelder, B. (1956) in: Discussions on Child Development, Vol 1. P.88.

Piaget, J. (1971) "The theory of stages in cognitive development", in: Green, D. et al (eds) Piaget and Measurement. P.3.

Uzgiris I and Hunt, J. (1975) cited in: Infant Perception: from sensation to cognition, Salapatek, C.

Corman, H. and Escalona, S. (1975) cited in: Infant Perception: from sensation to cognition, Salapatek, C.

seen as hierarchical and sequential, the measurement process does not seem to be. One is tempted to suspect that here, Nivette has forgotten that Piagetian measurement is about a continuum of organisation and that it is not the tasks that ascend in order of difficulty and points, but the responses which are to be classified in order of increasing organisation. Nevertheless, Nivette draws attention to the problem of how, even starting with a unitary concept (of creativity), one goes about 'dissecting' the continuum for descriptive and assessment purposes.

Once again the problem returns us to initial concepts and definitions. On the concept of knowledge, Piaget makes statements which have implications for assessment:

"Knowledge is a continuous process and cannot be chrystallised in any one of its momentary states..." (1972)

Whilst admitting the truth of Piaget's statement, it is believed that knowledge can be categorised. This allows one to conceive of knowledge as a continuum, but it also requires the construction of delicate categories for assessment if the transitional states of knowledge are to be trapped in assessment. Miller and Heldmeyer (1975) make a related comment in their criticism of some classical Piagetian types of assessment, arguing that often such assessments fail to take account of the fact that abilities in a state of development require sensitive, facilitating measures.

Given that a continuum of increasing cognitive organisation underlies all such categories, is indeed the ground of all such categories, categories must be hierarchical by nature. The stages themselves might

Nivette, J. (1971) in: Measurement and Piaget, Green, D. et al.

Piaget, J. (1972) Psychology & Epistemology: Towards a Theory of Knowledge. P.47.

Miller, P. and Heldmeyer, K. (1975) "Perceptual information in conservation: effects of screening", Ch. Devt. 46. pp 588-92.

well be seen as major categories. Each stage represents a certain level of organisation - each more organised than the previous. Within the stages themselves (and each stage and every point within a stage is essentially transitional) there are likewise degrees of ascending organisation. Stage-statements become hierarchical on the basis of criteria which indicate changes in the quality of cognitive organisation. Finer classifications can take place on the same bases. In other words, the researcher is not obliged to order items for assessment - stemming from a concept of increasing organisation they arrive in a sense (if rightly observed and psychologically defined) ready ordered. However, though such an idea may appear to be simple, this is deceptively so.

Earlier this century Thurstone commented that:

"The whole study of intelligence measurement can hardly have two more fundamental difficulties than the lack of a unit of measurement and the lack of an origin from which to measure."

Thurstone seemed to solve (statistically at least) the problem of the absolute zero, but the search for an adequate unit of measure continues. Working on a concept of a continuum of increasing organisation (cognitive) questions such as intervals between items or categories, context-specific problems and status and relationships of items or categories across areas of assessment continue to arise. To illustrate the complexities, it may help to examine one Piagetian concept - that of conservation. Conservation is often a context-specific notion. Ability to conserve certain properties in certain forms is attained before it can be applied to other forms. It is only at a certain stage of development that one can speak of a child as a conserver and mean this in the sense of a general ability as opposed to a length-specific-ability for instance. What is required

Thurstone, L.L. (1928) "The absolute zero in intelligence measurement", Psy. Rev. 35, pp 175-97.

then in tentative researches into a Piagetian type scale are categories which are in fact statements about levels of organisation, and which are not tied to specific abilities or contexts.

Because Piaget did not intend to systematise he has not really done so. This is not to say that his extensive research does not provide ground-work for some tentative ideas about systematisation. His stages, and in particular his sub-stages, could be seen as starting points. Whilst Piaget in his theory has emphasised continuity, with a central explanation in terms of organisation, his own research pattern has been somewhat unsystematic - in that some areas have been heavily investigated, others minimally so, and further, whilst he has always implied relationship across areas, this has rarely been made explicit. It is obvious, for instance, that development in moral judgement is governed by the same mechanisms that govern development in, say, spatial relations, but because Piaget employs context-specific categories to describe and classify it is not possible to relate the two areas with any real precision.

Categories for a tentative scale of creative ability have been influenced by Piaget's stage concept and his sub-stages in general, and also by the categories (especially sub-categories) of assessment employed in the first part of this research.

In attempting to develop a scale, apart from stressing its tentative nature (ideally it should be regarded as a hypothesis for future research) certain points must be emphasised:

- a) The intention is to develop an ordinal as opposed to a purely nominal scale, but the ordinal nature will derive from the quality of the responses and not from the nature of the items (Cf. Uzgiris and Hunt, 1975, *ibid*).

b) Unlike Corman and Escalona (1975, *ibid*) who developed a set of items to represent each stage, the intention, within certain limits, is to develop one set of items for use across the Piagetian stages. The sensori-motor and early pre-operational stages pose problems here, for it is clear that minimal skills would be needed for assessment of certain items even though these skills in themselves would not be assessed. The major reason against constructing sets of items for different stages stems from the belief that concern should be with the construction of the same realities over and against increasing cognitive organisation. It could be more difficult to assess this using different items, for variations might then stem from the different items themselves. Items would attempt to embody the major principles believed to underpin creative abilities. Creative ability is governed and explained by these major principles, and each principle, in its expression, is believed to undergo qualitative changes owing to increased cognitive organisation within the individual.

The proposed scale could be used for two purposes:

- a) To assess developmentally. This would allow one to consider the development of the major principles in relation to one another.
- b) To assess the existence/non-existence of creative abilities using the higher categories of the scale only.

TOWARDS A SCALE FOR THE ASSESSMENT OF OPERATIONAL CREATIVITY

The rationale underpinning this proposed scale is that of increasing cognitive organisation. Creativity is concerned with the organisation and re-organisation of reality, and this 'external' organisation must be

understood in relation to the internal cognitive organisation of the individual. The intention is to generate general categories (in the sense that they are not item-specific) in order to examine the principles believed to underpin creative behaviour. Every creative principle has a convergent counterpart (e.g. Construction - Re-construction, etc.)

Of the eight principles stated in the Introduction and employed in Part 1 of the research that of Apprehension and Definition is believed to be a major principle upon which the others are dependent. This principle has its roots in Piaget's object concept and explains an individual's growing understanding of the structure of objects and events. Without this understanding, he cannot relate, adjust, re-structure reality, etc. One has first to understand what is, before going on to what might be.

APPREHENSION AND DEFINITION PRINCIPLE

pre-operational		concrete operations		formal operations
object concept	relative interpretation	ego-centric distortions	concrete comprehension	formal comprehension

Because this is a fundamental principle, a concern in assessment and analysis with a scale of this type would obviously be to consider the relationship between performance here and performance on subsequent principles. The final scale would be ordinal in nature in terms of the responses - indicating increasing cognitive organisation.

The first principle - Apprehension and Definition - is essentially concerned with conception and cannot therefore be classified on the scale employed for the following principles, all of which involve re-organisation in some way.

Principle	pre-operational			concrete operational		formal operational	
	random, non-deliberate	intentional	schematic	grasp of implication (concrete)	grasp of implication (formal)		
Re-construction							
Re-relating							
Adjusting							
Adding							
Subtracting							
Multiplying							
Dividing							

The major principles have been explained in detail in the introduction and throughout the research. The categories proposed would be concerned to classify responses as follows:

a) Random, non-deliberate

This type of response was found among some of the younger subjects in Part 1 of this research. In responding thus they altered structures without any clear intention, with no definite outcome in mind and usually with no conclusion.

b) Intentional

Responses are deliberate and intentional though lacking in organisation and coherence.

c) Schematic

Responses suggest evidence of early organisation though there is still much evidence of ego-centric distortion and impressionism.

d) Grasp of Implication (concrete)

Where tasks are presented in concrete form the subject is able to re-organise and to grasp the implications.

e) Grasp of Implication (formal)

Here the subject is able to re-structure reality and to grasp its implication without concrete aids. More, even activities carried out in 'concrete form' are transformed by foresight and hindsight of an operational type.

It should be stressed that this is a mere hypothesis stemming from observations in this research. However, it is important as a hypothesis, if only because it gives a direction to thinking about scales for the assessment of creativity. The categories of the scale, which are descriptions of the quality and level of the transformation (e.g. Elaborating) are clearly crude at this hypothetical level, but they are important. They suggest that constructions and re-constructions of reality be evaluated in terms of the level of the act, and not that the act itself be accorded a position on a scale of ascending difficulty. According to his ability so an individual would be able to carry out a transformation either wholly and correctly or to a certain level ("task-level"). The search for "task-levels" in the first part of this research and the attempt to understand transitions from one level to another in the training section of the research forms some of the thinking behind this proposed scale.

In the research undertaken here, the intention was not to conclude by establishing a scale with which to assess creative ability, though the possibility of moving towards such an objective in the future is not

denied. Whilst a main aim was to re-define and assess creativity in structural terms the categories of assessment employed were by no means context-specific, and as indicated form the bases for possible categories for the proposed scale. The categories were evaluated to see if they could be regarded as context-free (as opposed to specific). In the Elaboration Task, for instance, "embeddedness" is used as one category. It relates in that instance to a drawing task, but can well be applied to other media. Essentially, it states that the stimulus provided does not dominate or wholly determine the final form of the elaboration. All categories were examined in this way, being applied theoretically to other media to attempt to see if they were in any sense bound by the context of media employed. Similarly, because the focus was on ability to construct and re-construct reality, and not upon the form of the re-construction (but on the conception, the idea) tasks had to be found that would not prevent the demonstration of the ability because of the specialist knowledge or skill required. For example, an individual may well have the ability to re-construct reality, he may well grasp the principle, but may not be able to apply it to, say, the re-construction of a car engine. This is a problem of a specific skill, as opposed to a basic ability dependent upon a certain level of cognitive organisation.

There is a certain arbitrariness in scoring - if only in terms of the narrowness or breadth of the categories employed. Much will depend upon the purpose of the investigation. For example, here, where the responses were divided into three categories of varying degrees of organisation (e.g. What Would Happen If Task, Re-constructions Tasks, etc), subjects were regarded as having satisfied the task requirements if they showed a minimum of organisation in their responses (i.e. if they fell into either category 1 or 2).

Whilst ultimately a developmental trend would have been observed overall, a stipulation that all subjects should have satisfied the highest category would have "delayed" agewise the appearance of ability. This in fact is an artifact of scoring. It need not detract from the underlying truth, but it does indicate some of the minor dilemmas of scoring, especially in a developmental study. To put the question another way; one might ask when an ability should be registered on a given scale, when it is firmly established, or when there is a certain degree of development? Scoring adjustments would be made according to the purpose.

Abilities 'in transition' can be especially difficult to assess and to score. Here rater bias can too easily be introduced. There is need for an adequate set of criteria by which one can give accurate psychological definition to such states. It is not difficult, for instance, to assess an individual as a conserver or non-conserver, but it is more difficult to establish criteria that place him somewhere between these two points. Clearly, Piaget met such problems (1969): commenting on this mid-stage, he says:

"(here) conservation is assumed but without certainty and in the case of some transformations only." P. 158

In areas where Piaget is more detailed, and attempts to seek out actual criteria (e.g. 1954 and others) he most often tends to be descriptive and above all context-specific. The criteria of the sub-stages relate only to those sub-stages in the area under consideration, and could not, as they stand, be applied more generally. Is it such general criteria that are needed if intelligence, as understood by Piaget, is to be assessed in some unitary manner. Clearly, his theory is unified but a more explicitly

Piaget, J. et al (1969) Experimental Psychology: Its Scope and Method. VII Intelligence. P.158.

Piaget, J. (1954) The Construction of Reality in the Child.

unified form of assessment would be an advantage. In the proposed scale for the assessment of creativity (operational) an attempt has been made to propose categories of this general type - not those of a context-specific type.

It seems appropriate to conclude with questions and suggestions which are directed towards future research possibilities stemming from this current research. If Piaget is to be more systematised, on the basis of extensive, less systematised initial research at the level of assessment and scoring, a further question might be: what possibilities of more sophisticated analysis of data exist? Piaget has always resisted such analysis in accordance with his purpose of attempting to understand the intellectual mechanisms used in the solution of problems, and of determining the mechanisms of reasoning (1956).

A search by factor analysis is generally a search after the event. Hendrickson & White (1966) and Schönenmann (1966) have attempted to state in advance what is likely to be a factor-structure in psychological terms and have then proceeded to manipulate the data to verify the adequacy of their initial hypotheses. Such a procedure would not satisfy Horn's requirements (1967):

"An objective procedure may be defined as one in which the investigator's theory does not enter into the actual determination of the solution."

Piaget, J. (1956) in: Discussions on Child Development, Vol 1. Tanner and Inhelder. P.89.

Hendrickson, A and White, P. (1966) cited in Butcher, H. (1968) Human Intelligence, Its Nature and Assessment.

Schönenmann, P.H. (1966) cited in Butcher, H. (1968) Ibid.

Horn, J.L. (1967) "On subjectivity in factor analysis", Educ. & Psychol. Measurement, 27, pp 811-20.

If Horn means by this that researchers must resist the temptation to juggle statistical relationships to reach a desired fit, then he is correct. But if he means that initial hunches, theories, definitions and questions are not subjective in the sense already suggested, then he is setting an impossible standard of objectivity.

There is a parallel to be drawn here between the concept of the "g" factor and the concept of organisation (cognitive). The search for a "g" factor was a search for unifying explanation of intelligence. Cattell (1971) distinguishing between what he called 'surface traits' and 'source traits' stated that the search was for:

"... some simple underlying factor which causes things to go together... a simple structure... given a unique position by confactor rotation."

Tuddenham (1971) prefers a new type of structural explanation of intelligence (which would include creativity) based on Piaget:

"... the dilapidation of factor theory has not destroyed the possibility that a structural theory of an entirely different sort, for example that of Piaget, might succeed where factor analysis has faltered."

If one were to apply some factoring type of approach to operational creativity, the approach would necessarily be rooted in the concept of increasing cognitive organisation. The factor of factors (Cf. "g") would be organisation itself, explicable in terms of operational structuralism. As a fundamental factor it would be hypothesised to be responsible for relationships between abilities based upon it, and the links between abilities would be in terms of organisation and intervals in degrees of cognitive organisation. Briefly, the approach would be that of hypothesis and verification (Hendrickson and White, 1966). Such an approach would have implications for the kinds of

Cattell, R. (1971) Abilities: Their Structure, Growth and Action. P.12.
 Tuddenham, R.D. (1971) "Theoretical regularities and individual idiosyncracies" in: Measurement and Piaget, Green et al. P.65.

starting concepts one could hold about intelligence. In general, factor analysts begin with a fragmented concept of intelligence. Nancy Bayley (1954), for instance, says:

"If the word intelligence' is best used as a broad general term that we apply to a great variety of mental functions, then we will want to investigate the nature of these functions, their inter-relationships and the changes that take place in mental organisation and growth. We should expect a given factor of intelligence to be more important at one stage of development than at another."

Essentially, such a statement reflects a non-wholistic view of intelligence - a concept eventually welded together by means of statistical relationships. In a Piagetian approach, all questions would be placed in the light of the initial theory which postulates a non-fragmented view of intelligence. Such a view could not speak of some abilities being more important at certain stages. In an organisational notion of intelligence, aspects of intelligence must be interdependent, and whilst one may speak of a hierarchy, and even of characteristic modes of functioning at different stages, it is not possible to extricate isolated abilities from the complexity of the organisation and pronounce them more or less important. Whilst such comments stress the importance of initial theoretical concepts, and the direction that these will give to investigation and analysis, it also stresses the point that rotational techniques might well encourage the exploration of relationships not initially conceived of. To return to an earlier comment: research is a movement from "hunches" and theory to verification - and then a return to the theoretical starting point.

Finally, some comment might be made on the significance of categories of assessment for training, for according to our notions of learning, so

we shall construct the categories for assessment. In their turn, such categories will affect training programmes if only because there is a tendency to 'train' to meet certain categories of assessment. (see Piagetian work on conservation, etc). On this matter Piaget comments:

"How does an individual arrive at his own norms of this kind? This is in essence a psychological question, independent of any competence... with respect to the evaluation of the cognitive significance of these norms; it is, for example, the business of the psychologist to determine whether these norms have simply been transmitted to the child through the adult (which is not the case), whether they depend upon a single experience (which is in fact not at all sufficient)... or whether they constitute the product of a structuring procedure which is in part endogenous and proceeds by adjustments and progressive self-regulatory procedures (which this time is the case)."

Gagné (1966) proposes a different interpretation regarding such norms, and in his own sphere he provides excellent examples of the implications which categories of assessment have in fact upon training schedules.

Employing a different philosophy Gagné (ibid) has shown how micro-structures can be useful in the study of instruction. Finer categories, as he illustrates, enable a greater understanding of the formation of abilities, for having established such categories one can, he believes, manipulate and observe the development of the abilities involved. The intention behind the training here was not in fact to train but to attempt to gain some closer understanding of the psychological mechanisms operating. The concern was with 'major categories' only and could indeed be a criticism of the schedule. Different though they are, both Piaget and Gagné would agree that experience itself makes no necessary sense, it has to be 'meaningful' to the individual concerned.

Piaget, J. (1972) Psychology and Epistemology: Towards a Theory of Knowledge. P. 7.

Gagné, R. (1966) The Conditions of Learning.

Observations and training sessions are the breeding ground of new categories for assessment. One can only assess what one has become aware of. The triangle tasks, whilst assessed primarily in terms of pass/fail and eventually of transfer, could be regarded in a more detailed way. There is evidence of increasing spatial awareness and of the inter-relation of items. Though in many instances this does not necessarily lead to the solution, it heralds a quite different approach by the subject to the process of solving the problem. This development may, at this point be 'context specific' - and any training improvement might be tied to this particular problem (a matter of 'décalage'), however an understanding of the inter-relations of things in time and space is generally to be applied to all problems and events. What is required for the future if Piagetian thinking is to lead to some systematic assessment of intelligence/creativity, is the establishment of detailed explanatory categories with clear criteria, and perhaps, a factorial examination of such categories in relation to one another. This present research is a springboard to this. It attempted to re-define creative behaviour and then to assess what was defined.

CONCLUSION

The most fundamental problems of the researcher into creativity are well encapsulated in Poole's phrase (1972) - 'a crisis of conceptuality'. In his discussion of methodologies and their implications, and paraphrasing Kuhn, Poole says:

"'Normal science'.... goes on 'puzzle-solving' at a low theoretical pressure until it reaches some problem it cannot solve under the aegis of its paradigm, there is a crisis of conceptuality, and this is when 'revolutionary science' is born."

Like the creative thinker, the researcher into creativity has to be 'revolutionary'. He has to study what is not yet known, classify what has yet to be classified with yet-to-be constructed categories. Research itself might well be looked at in terms of the construction and re-construction of reality for in this sense the researcher truly creates the problems (Goffman, 1966). Indeed the very research process could be explained in terms of the principles of creativity as here proposed - namely, re-apprehension and re-definition of reality leading to new constructions and knowing.

In an area such as creativity, that is still open to definition and more adequate theorising, research tension stems from the need, on the one hand, of an adequate theory as opposed to fragmented explanations and comments, and the desire, on the other hand, to be free from the determinism of known patterns. Kuhn (1973) makes the point that:

"In the absence of a paradigm... all of the facts that could possibly pertain to the development of a given science are likely to seem equally relevant. As a result, early fact-gathering is a far more nearly random activity than the one that subsequent scientific development makes familiar."

Poole, R. (1972) Towards Deep Subjectivity. P.48

Goffman, E. (1966) Stigma.

Kuhn, T.S. (1973) The Structure of Scientific Revolutions. Vol 11, No 2, P.15.

The researcher into creativity has a yet deeper problem, for he may not wish to be concerned with facts, and still less with known facts. Definitions and methodologies are closely inter-related.

In his criticism of what might be termed 'over-empiricism', Poole (ibid) makes the point that objectivity:

"... selects what it intends to consider very carefully. It selects those parts of a problem which are either quantifiable or empirically governable or both."

It is a pity that defence of one level of analysis often leads to rejection of another. Whilst reductionism is not to be encouraged, each level of analysis can be seen to serve very different intentions. There is a place for focus on 'objectivity' in interpretation of reality as there is a place for more phenomenologically based meaning. Whatever their position on this continuum, all researchers are limited by their initial conceptions and could be re-powered by a 'crisis of conceptuality'. Poole himself, who proposes a method of 'subjective reflection' in an attempt to come to terms with the complexities of reality, is subject to this same limitation.

A 'crisis of conceptuality' could have subsequent implications for actual research methodology. Hudson (1966) believes that some innovation is needed here:

"After an initial period of innovation and experiment, progress slackened. Instead of developing more subtle tests, psychologists concentrated on the analysis of results culled from tests they already possessed."

Poole, R. (1972) Ibid.

Hudson, L. (1966) Contrary Imaginations. P.3.

Unless definitions and methodologies continue to interact, there will be the problem of forcing new conceptions into old methodological wine-skins. Such new conceptions could weaken 'methodological set'.

As already suggested, re-constructions of reality - or crises of conceptuality - cannot be ordered to time. It is likely, therefore, that much research into creativity will proceed step-by-step, with gradually increased understanding leading to different constructions of the problem in hand. As explained, re-apprehension can come about at any stage in the process of potentially creative behaviour, and research might well be seen as such a process.

Mary Hesse (1972) proposes a model of research which regards the process in terms of feedback. Citing Habermas, and arguing that the model can be equally well applied to 'human sciences', she says:

"Habermas makes frequent use of the concepts of successful prediction, feedback and self-correction. In effect this is to appeal to a model of natural science as a learning machine. It is not difficult to incorporate most of the features of natural science as at present understood into such a model. The presence of feedback loops in a learning machine allows for the circular self-correction of theory by experience and experience by theory that is demanded by interpretation of science as theory laden."

Hesse, M. (1972) "In defence of objectivity", read 4 Oct. Proceedings of the Brit. Acad. (1973).

Research, like the creative process, is about construction and re-construction of reality. It can probe these constructions from different angles and at different levels of analysis. Man is an everyday researcher, and research might best be explained as the development of knowledge. The notion of development should be stressed, for as the knowledge of the individual can be characterised by a series of hierarchical stages, so too the knowledge of the researcher moves from pre-operational intuitions to more operationally governed activities and reflections.

APPENDICES

APPENDIX I

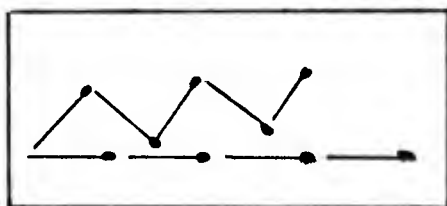
Further details on the pre-pilot work
for Part 1.

Pre-Pilot Tasks for Part 1 of Research

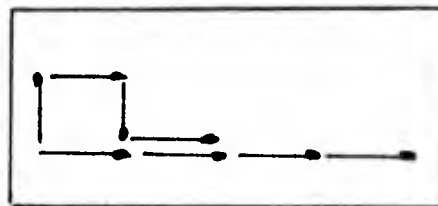
12 subjects - 6 boys and 6 girls, representing the age groups, were finally studied.

Cards employed (adapted from Hermina Sinclair, 1973)

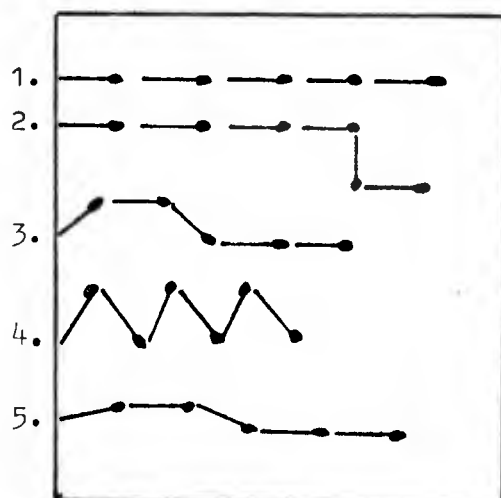
a) Discontinuous units of equal length (matchsticks).



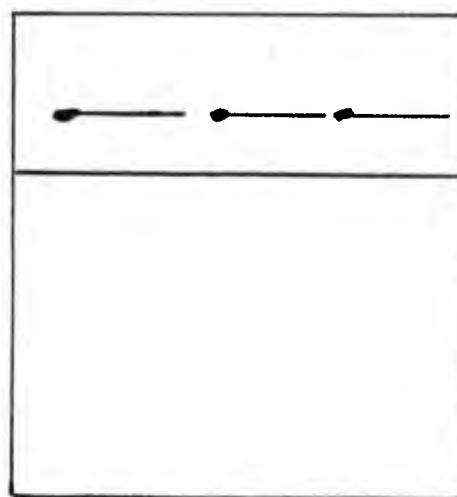
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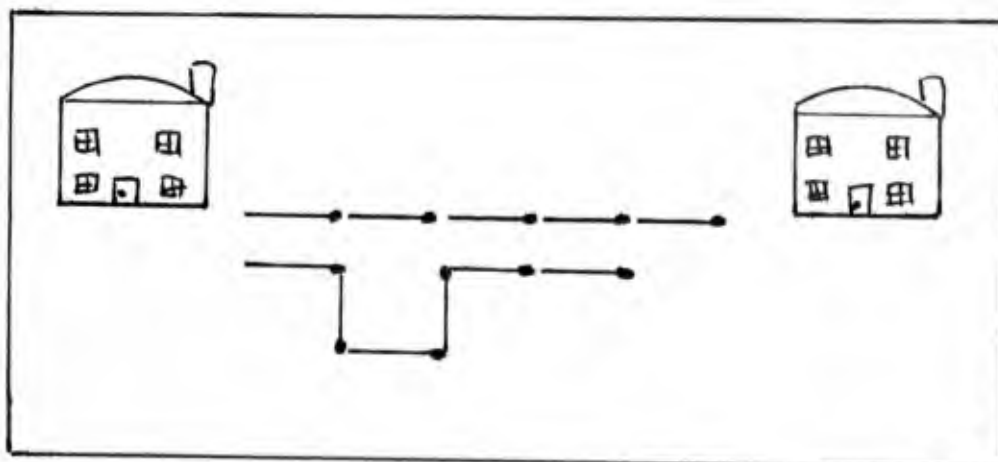
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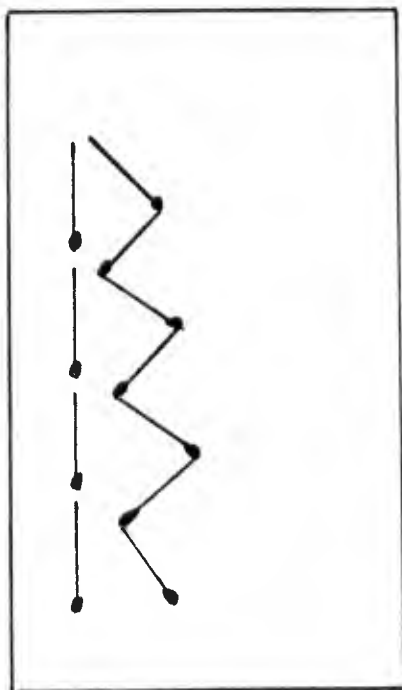
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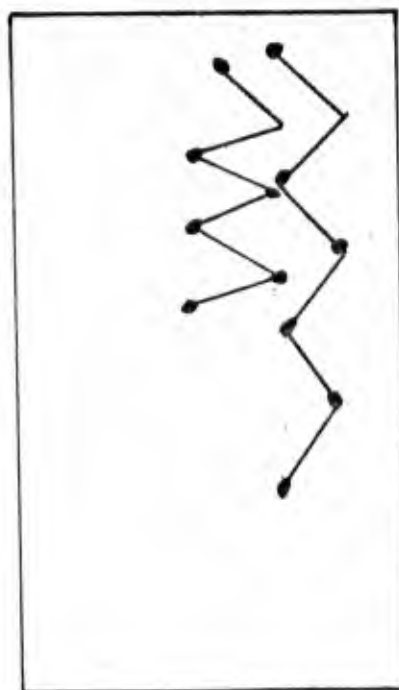
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5.

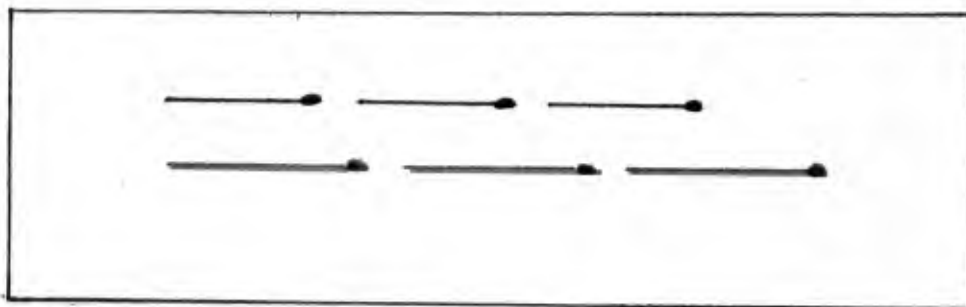


6.

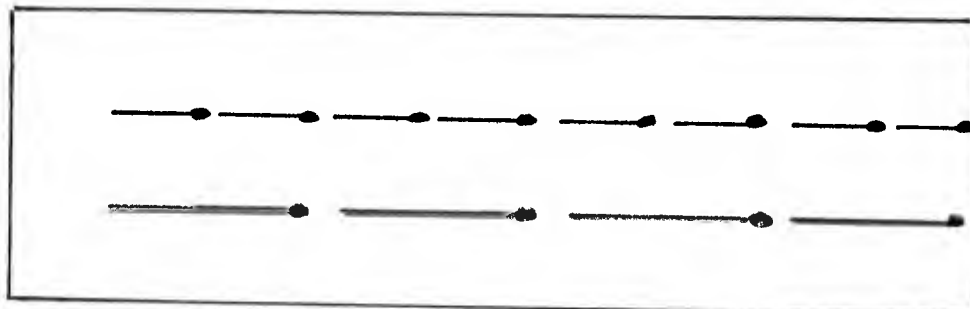


7.

b) Discontinuous units of unequal length.



8.



9.

The following is a transcript of part of a session with an eight year old subject (girl), using the cards just illustrated:

Card 1

Q. Are these two lines the same?

"No, because that one's straight and that not."

"The straight one's longer than the other. You can see the difference."

Q. Can you show me the difference?

"Well, if you had another there, then they would be the same length."

Card 2

Q. Not the same.

"The straight one again is longer, and there is a different shape." .

Q. And the straight one is the longer one?

"Yes."

Q. Which one goes the further?

"The straight one."

Q. Which would be the quicker road to walk along?

"I would say the longest one, because you don't have to keep turning too much."

(Experimenting with matches prior to Card 3)

(Builds roads with matches, same length, but different shapes)

"Not the same length."

Q. Have they both got the same number of matches in?

"Yes."

Q. If you flattened that road out, would it be the same length (as the other road)?

"Yes."

Q. If we changed the shape of this straight road, would it be the same length?

"No, it would be shorter (Uncertain)"

Q. If we had the same number of matches, would the roads be the same length?

"Yes, the problem is they don't come to the same length."

Card 3

(Indicates number 1 as longest road)

"Because it's straight."

Q. Which has got the most road in it?

(Indicates the zig-zag (No.4) as having "more road in it", but insists it is shorter than No.1.)

(Is asked to build these roads.)

"Straight one is longer."

"Bottom one has more road in it (sees it has more matches)."

Card 4 (Builds two roads in the two squares.)

Q. Are these two roads the same length?

"No, bottom one is the longest, because it's got more pieces of road."

Card 5

"The straight road is the longest road, because it just goes further along."

Q. Which road has got the most road in?	{ seems to be aware of number of units but insists that length is related to straightness and "going further", etc.
"The bottom one, it's got six."	
Q. Which is the quickest road?	

"The straight one, because you don't have to turn too much."

Q. If you flattened these roads out, which would be the longer road?

"The bottom one (quite sure of this)".

Card 6

Q. What's the same about these two lines, Angela?

"It's got the same amount. (counts them, sees her error) No, it's just that they start at the same time and end at the same time."

Q. Has one got more road in than the other?

"Yes, this (zig-zag) has more road."

Q. Are they both the same length?

"Yes... because they start at the same time and end at the same time."

Q. Has this got less road in it than this one (straight v. zig-zag)?

"(Answers correctly) Yes, because it's only got four pieces"

Q. If you flattened them out, which would be the longer road?

"The one with five in."

Card 7

Q. What's the same about these two lines?

"They're both the same shape but they're not both the same amount."

(Counts, realises her error) "They're both the same amount, but they start together at the top, but they don't end together."

Q. Are they both the same length?

"No, because that's shorter than the other one."

Q. Have they both got the same amount of road in?

"Yes (quite sure of this)."

Q. If you stretched them both out would they both be the same length?

"Yes (quite certain)"

Q. What do you mean when you say something is the same length, Angela?

"They start together and they end together."

Card 8

"The green straw is longer."

Q. Have they both got the same number of pieces in?

"Yes..."

Q. Why is the blue one shorter even though they've both got three?

"You've cut the blue one a bit shorter."

(Asked to make two roads of same length, with blue and green sticks.)

Counts five sticks in green. Knows she will need more blue sticks

"because if I only use five blue ones it won't be as long."

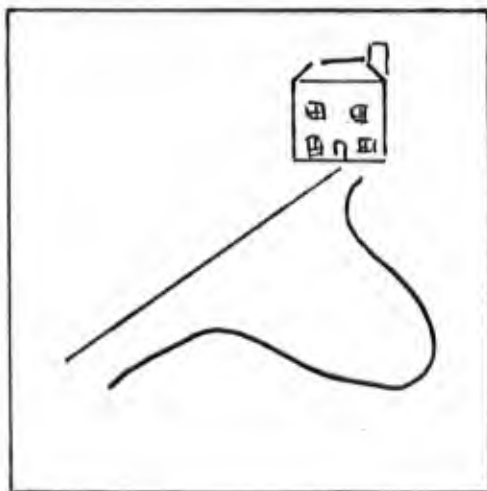
Card 9

Q. Are these two lines the same?

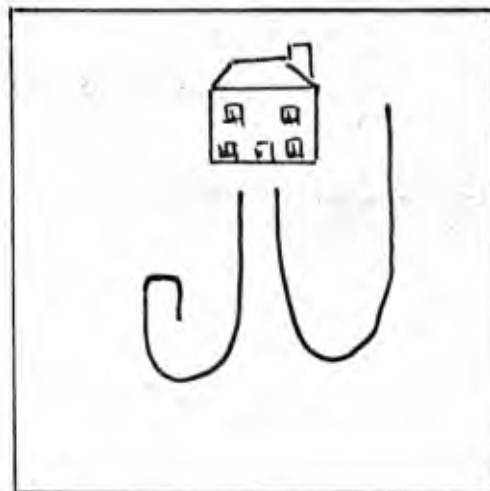
"Yes, because you put more in than you did that one."

Q. Why are they the same length...?

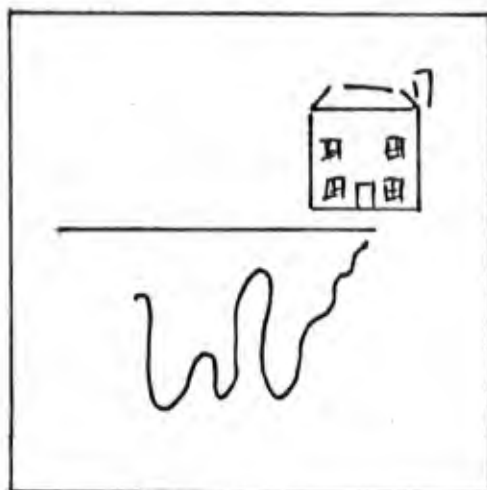
"Because you started them at the same time and you ended them at the same way."

c) Discontinuous units (string)

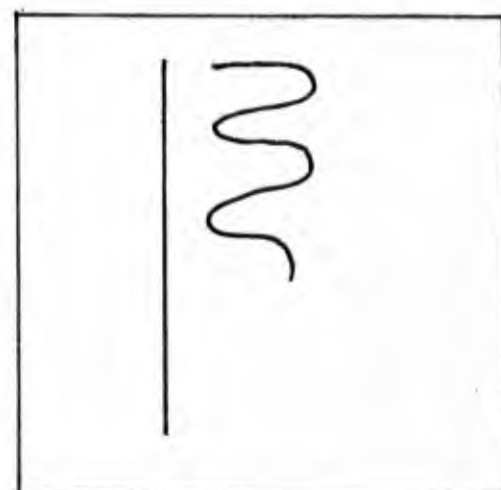
1.



2.



3.



4.

The above cards (6" x 6") were used in the same way - i.e. to examine concepts of length, conservation of length, and grasp of 'changes in appearance.

The following questions were put to subjects in this pre-pilot work
-- in conjunction with the cards just described:

Continuous units (string)

Card 1

Which is the longer line here? Why?

Which has more string in it?

If this line were stretched out which would be the longer? How do you know?

(Give child experience with string as needed)

Card 2

Which is the longer road here?

Which has got the most road in it?

If they were both stretched out which would be the longer?

Which is the quickest road to the house?

Which road goes further?

Card 3

Which is the longer road on this card? Why?

Which is the quicker road?

Which road has more road in it?

If the curved road were stretched out, which would be the longer?

Which road goes the furthest?

Card 4

Which is the longer road here?

Which is the quicker road? Why?

Which road has more road in it?

If the road were stretched out, which would be the longer? Why?

Which road goes the furthest?

APPENDIX II

Further details on pre-pilot work
for Part 2.

Pre-Pilot Work for Part 2 of the Research

6 subjects in all - 3 in 7-8 years range, 3 in the 9-10 years range.

An Individual Training Session on a Re-construction Task:

Subject: Boy aged 7:6 (illustration over page)

The child was presented with the card showing the block of flats - 5 floors, 4 windows on each, the ground floor having round windows.

He was asked: How could you make this look different? You are not allowed to add things and you must use everything shown here.

S. "Can you just change these round and put them in a different place?"

E. Yes.

S. "Oh, then it's easy, you just do this."

He then counted the number of squares, drew the outline of the flat, filled in the circles then the remaining squares.

He was then asked: Could you make this building (see card) into two buildings, each building being different from the other?

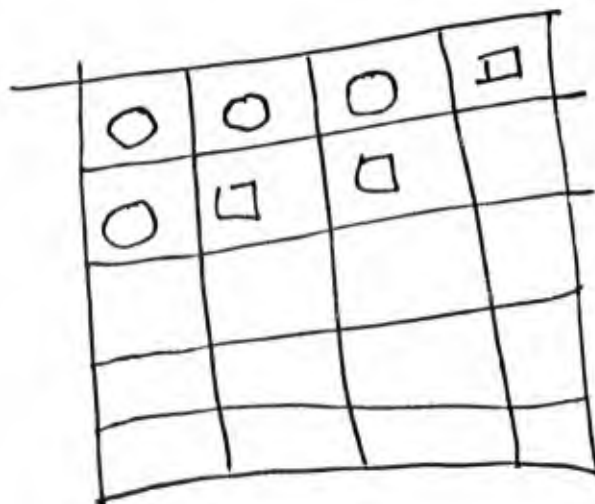
S. "You could just cut it in half down the middle like this?"

E. Yes, and how would you make them look different?

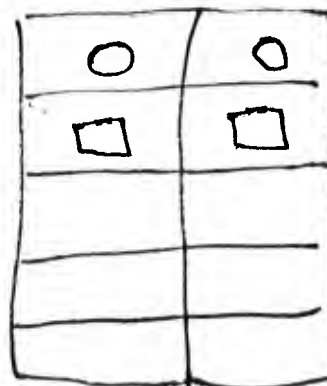
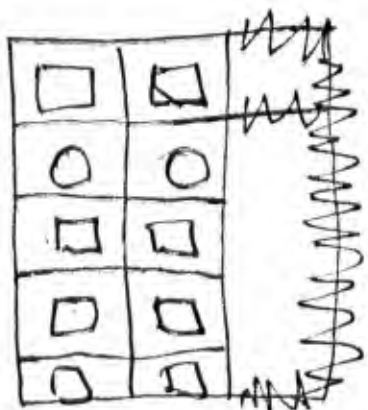
S. "You could put the windows in different places like this."

He simply placed the round windows on a different floor in each building, using two round ones for each.

Next he was asked: This time I would like you to make the building into two buildings again, but this time I would like you to have a different number of windows in each one. (continued on Page 500)



First correct attempt to make the building look different. Filled in the 4 circles and a few squares then pointed out that all the rest would just be square windows.



First correct attempt to make two buildings out of one. The subject asked if it were necessary to separate the two buildings. He pointed out the different positions of the round windows in each block and said all the rest would be square windows and that there was no need to fill them in.

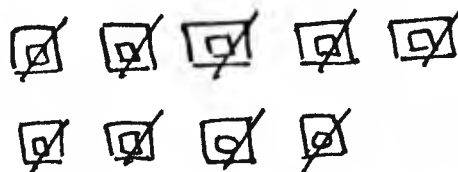
S. "I don't know what you mean."

E. Well, supposing you made this building into two, and you used six of the blocks for one of the buildings, how many blocks would you have to use for the second building?

The subject was clearly confused, yet he subtracted well. It was felt that the problem was being put in a manner which hindered his perception of it. A main difficulty was that he had not as yet realised that the building could be perceived as 'units' - blocks. He still adhered to the rectangular outline. He had divided the building in Task 1 to a way which avoided a fundamental grasp of its structure.

The following method was then employed:

Now, here you have 9 blocks with the windows in. Build a building with them and cross them off as you use them. (An uneven number was chosen deliberately.)



S. "Oh, this is good because you don't get caught out if you have one left over at the end."



(A reference to the problem of adhering to a rectangular outline as he had done previously.)

Once he realised that this approach was possible, he was well able to construct buildings of different shapes so long as he defined the shape as he went along, i.e. not in advance. Initially, he had not perceived the building as individual units.

The early problem was put again:

First it was put as 9 blocks - and he was asked to make 2 buildings with a different number in each.



Next he was asked to make two buildings from the card. This time he could do it.

Comments:

With this particular child, an introduction to another way of defining the building was important. It increased the possibilities of re-constructing the block of flats and the ways of doing so. From his comments it was clear that he understood some of the advantages of the approach. Some training can contribute to some advances therefore. However, whilst he was ahead of his age group in his ability to see some of the possibilities of perceiving the building as a number of separate units, he exhibited certain limitations in his use of them. He was unable to anticipate the final shape and his shapes lacked organisation or formation and were generally units put together with the gaps occurring as they occurred and not through planning. In other words, whilst the presentation of a new way of perceiving the problem was important to him and to further re-constructions, further step by step training would be needed in an attempt to present him with further organisational possibilities. Further, it would seem that the training would have to be suited to his own particular case, his own advances and interpretations, and could not therefore be a scheme for a group of subjects.

APPENDIX III

Detailed Subject Profiles

(Part 1 of Research)

PERFORMANCE ON SUB-CATEGORIES BY AGE (Figures in columns denote frequencies.)

Task	Sub-Categories	Age in years. (12 subjects in each age group).							
		6 yrs.	7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.
A									
<u>Elaboration</u>									
	1 redefinition.	1	3	6	6	8	10	11	11
	2 Embeddedness.	0	0	1	0	4	5	6	6
B.									
<u>Free Problem Solving</u>									
PART 1 of task	3 paradigmatic responses.	0	1	0	3	4	6	10	12
	4 non-paradigmatic responses.	12	11	12	9	8	6	2	0
PART 2 of task	5 systematic response.	0	0	0	0	0	2	4	6
	6 partially systematic	1	2	1	4	6	5	6	5
	7 non-systematic.	11	10	11	8	6	5	2	1
C									
<u>Identity Re-Construction</u>									
PART 1 of task	(1) 8 organised response.	0	0	1	0	1	5	5	6
	9 partly organised.	0	2	6	7	9	5	6	4
	10 disorganised.	12	10	5	5	2	2	1	2
PART 2 of task	11 correct change.	1	0	3	8	9	12	12	12
	12 correct division.	0	0	3	6	6	7	9	12
	13 correct shape change.	0	0	2	3	3	3	5	6
D									
<u>Identity Recognition.</u>									
	14 re-definition	1	0	3	5	6	6	8	8
	15 use of 1/3 of stimulus lines.	2	0	3	6	6	7	9	9

<u>Task.</u>	<u>sub categories.</u>	<u>Age in years.</u>							
		6	7	8	9	10	11	12	13
<u>E</u> What Would Happen If?	16 well related	0	0	0	1	0	2	5	7
	17 partially so.	0	0	2	.5	6	5	5	3
	18 unrelated. (ego-centric)	12	12	10	6	6	5	2	2

<u>F.</u>									
<u>Re-classification</u>									
19	objective criteria used.	* -	5	4	5	5	6	4	3
20	Associative criteria used.	* -	4	5	6	6	6	8	9
21	satisfied fluency criteria.	* -	0	1	1	2	4	6	7

* scores for 6 year olds not included. too difficult.

9.

Re-Construction

(2)

PART I of task	22	organised response.	0	0	0	0	1	4	5	6
	23	partly organised.	0	2	6	7	9	7	6	6
	24	disorganised.	12	10	6	5	2	1	1	0
PART 2. of task.	25	correct figural definition.	0	2	4	6	8	10	11	11
	26	constructive use of stimulus.	0	1	2	3	5	6	5	7

Subject Profile.Age. 6 years.

+ = passed on that item. 1st. 6 Ss. = Girls.

No.	Age.	Elab.	Free Prob.	Ident. Recog.	Ident. Reconstr. (1)	Wh.Wd. Happen?	Re-Class.	Ident. Re-Const. (2)
-----	------	-------	---------------	------------------	----------------------------	-------------------	-----------	----------------------------

1. 6.8.

+

2. 6.7

3. 6.7.

4. 6.5.

5. 6.9

6. 6.2

7. 6.8

8. 6.7

9. 6.8

10. 6.10

11. 6.4

12. 6.5.

0

0

1

0

0

0

0

Age 7 years.

13. 7.7.

14. 7.6.

15. 7.6

16. 7.5

17. 7.6.

18. 7.4

19. 7.6.

20. 7.8.

21. 7.9.

+

22. 7.7.

23. 7.8.

24. 7.4.

0

0

0

0

0

0

1

No.	Age.	Elab.	Free Prob.	Ident. Recog.	Ident. Recon. (1)	Wh.Wd. Happen?	Re-Class.	Ident. Re-Con. (2)
-----	------	-------	---------------	------------------	-------------------------	-------------------	-----------	--------------------------

25 8.5

26 8.7

27 8.2

28 8.11

29 8.1

30 8.8

31 8.6

32 8.8

33 8.10

34 8.8

35 8.10

36 8.5.

1

0

3

2

2

1

2

9 years.

37. 9.10

38 9.11

39 9.8

40 9.5

41 9.2

42 9.3

43 9.8

44 9.1

45 9.2

46 9.3

47 9.6

48 9.4

2

2

4

3

5

1

3.

10 years.

No.	Age.	Elab.	Free Prob.	Ident. Recog.	Ident. Recon. (1)	Wh.Wd. Happen?	Re-Class.	Ident. Re-Con. (2)
-----	------	-------	------------	---------------	-------------------	----------------	-----------	--------------------

49	10.6							
50	10.6	+		+				+
51	10.8		+			+	+	
52	10.7		+			+		
53	10.7	+		+		+		
54	10.4	+		+	+			+
55	10.9		+	+	+			+
56	10.5	+				+		+
57	10.6			+	+	+		+
58	10.8		+				+	
59	10.2			+				
60	10.4					+		

4	4	6	3	6	2	5
---	---	---	---	---	---	---

11 years.

61	11.0	+	+	+	+	+	+	
62	11.2	+	+	+		+	+	
63	11.3					+		
64	11.8							
65	11.4							+
66	11.8			+				+
67	11.7		+	+		+		+
68	11.6			+		+		
69	11.0			+			+	+
70	11.6	+			+	+		+
71	11.5	+	+		+			+
72	11.6	+				+	+	

5	4	6	3	7	4	6
---	---	---	---	---	---	---

308
12 years.

No.	Age.	Elab.	Free Prob.	Ident. Recog.	Ident. Recon. (1)	Wh.Wd. Happen?	Re-Class.	Ident. Recon. (2)
73	12.6	+	+	+	+	+	+	+
74	12.4		+	+	+	+	+	
75	12.8			+		+		
76	12.10	+	+			+	+	
77	12.8	+	+	+	+	+		+
78	12.2							
79	12.4					+		+
80	12.10	+	+	+	+	+	+	+
81	12.2	+	+	+	+	+	+	+
82	12.8					+		
83	12.6	+		+				
84	12.5		+	+		+	+	
		6	8	8	5	10	6	5

13 years.

85	13.2	+	+	+	+	+	+	+
86	13.10	+		+	+	+		+
87	13.6		+	+		+	+	
88	13.8		+					+
89	13.4	+	+		+	+	+	
90	13.6	+	+	+		+	+	+
91	13.11		+	+	+	+	+	
92	13.5					+		+
93	13.2	+	+	+	+	+	+	+
94	13.8			+				
95	13.6	+	+				+	
96	13.5		+	+	+	+		+
		6	9	8	6	9	7	7

APPENDIX IV

Detailed Subject Profiles
(Part 2 of Research)

		BOYS: 9 - 10 years. (* = additional Ss.)										<u>(+ = item passed)</u>									
Items (pretest)	Ss. No.	2	3	4	5	6	7	9	10	14	15	16	18	20	21	22	23	24	25	*26	*27.
Shape recognition		+	+	+	+			+		+	+	+		+	+		+	+		+	
Elaboration			+	+				+			+		+	+				+		+	
Fails Re-structuring but relates component parts (1)		+	+	+			+						+	+			+	+		+	
Fails Re-structuring but relates component parts (2)				+									+				+			+	
<u>Items (post-test)</u>																					
Restructuring 1 correct.		+	+	+		+	+				+		+				+			+	
Restructuring 1 incorrect but relates parts.					+			+		+				+	+	+		+			+
Restructuring 2 correct		+	+	+				+		+	+	+	+	+	+		+	+		+	
Restructuring 2 incorrect but relates parts.					+				+							+			+		
Transfer Task Correct.		+	+	+				+					+								510.

GIRLS: 9 - 10 years. (* additional Ss)

(+ = items passed)

Items (pretest)	Ss. No	1	2	5	9	10	11	13	14	15	18	19	20	21	22	23	24	25	26	27	28
Shape recognition		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Elaboration		+			+	+	+	+	+	+		+	+						+		+
Fails Re-structuring but relates component parts (1)		+			+	+	+	+	+	+	+		+	+	+		+		+		+
Fails Re-structuring but relates component parts (2)					+	+		+	+	+			+				+		+		+
Items (post-test)																					
Restructuring 1 correct.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Restructuring 1 incorrect but relates parts.						+					+					+		+		+	
Restructuring 2 correct				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Restructuring 2 incorrect but relates parts.																					
Transfer Task Correct.			+				+		+	+		+	+				+		+		

(+ = item passed)

BOYS: 7 - 8 years.

Items (pretest)	Ss.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Shape recognition						+						+						+			+
Elaboration				+								+	+			+		+			
Fails Re-structuring but relates component parts (1)						+	+	+				+				+		+			
Fails Re-structuring but relates component parts (2)				+		+	+										+	+			
Items (post-test)																					
Restructuring 1 correct.						+	+	+										+			
Restructuring 1 incorrect but relates parts.		+		+		+					+	+				+					
Restructuring 2 correct				+		+		+										+			
Restructuring 2 incorrect but relates parts.						+															
Transfer Task Correct.																					+

GIRLS: 7 - 8 years.

(+ = item passed)

Items (pretest)	Ss.No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Shape recognition		+	+	+					+				+								
Elaboration		+			+	+								+					+		
Fails Re-structuring but relates component parts (1)		+	+	+	+	+								+		+					
Fails Re-structuring but relates component parts (2)				+										+							
<u>Items (post-test)</u>																					
Restructuring 1 correct.				+																	
Restructuring 1 incorrect but relates parts.		+	+		+							+	+	+		+	+		+		+
Restructuring 2 correct				+										+					+		+
Restructuring 2 incorrect but relates parts.																					
Transfer Task Correct.				+																	

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